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PLANTS, Trees, Seaweeds, &c.—C. de Saint Prix, 1627.

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PROPELLING Carriages.—F. Agnew, J. Walker, and G. Dorset, 1808. A. P. Price (com.), 1916.

PROPELLING Machinery, Transmitting Power and Motion, Converting Movements.—W. R. Lake (com.), 1662. A. M. Clark (com.), 1740. W. Clark, 1758. A. M. Clark (com.), 1834. P. la Cour, 1988.

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PULLEYS.—W. Webster, 1816.

PUMPS, Pumping and Raising Water and other Liquids, Pumps, Pistons, and Packing.—W. Morgan-Brown (com.), 1637. A. M. Clark (com.), 1687. J. Evans, 1711. F. H. F. Engel (com.), 1714. G. F. Fosbery, 1724. W. Blackwell, 1921. C. W. King and A. Cliff, 1963.

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RAGS and Waste, &c.—A. V. Newton (com.), 1856.

RAILWAYS, Permanent Way, Rail Joints, Chairs and Sleepers, Portable Railways, Atmospheric Railways, Switches, points, Crossings, and Turntables.—J. J. Halcombe, 1616. A. V. Newton (com.), 1670. W. S. Oxborrow, 1739. A. M. Clark (com.), 1892. S. Fox, 2005.

RAILWAYS, Carriages, Coupling, Uncoupling, and Altering Position of Carriages and Engines.—G. E. Gray, 1618. F. W. Fox, E. Walker, and E. Perrett, 1620. W. D. A. Mann, 1718. F. R. Hutton, 1736. J. Buchanan, 1737. D. Drummond, 1762. H. A. Silver, 1817. W. Mawlam, 1848. F. H. F. Engel (com.), 1915. P. C. Langshaw, 1999. A. H. Beavan, 2000.

REAPING, Mowing, Making Hay, Gathering in Produce.—T. Greene, 1631. W. G. Cowlishaw, 1648. T. Peckett, 1776.

REFRIGERATING, Cooling Liquids, Making Ice.—F. Windhausen, 1678. W. D. A. Mann, 1718. W. Hargreaves, 1747. C. P. Edney, 1873.

REGISTERING, Indicating, and marking.—W. H. Tetley and S. Clayton, 1633. A. V. Newton (com.), 1670. A. G. Smith, 1679. C. E. Kelway, 1748. E. R. Corrie, 1787. J. G. Wilson (com.) 1801. A. W. Baker, 1991.

RETORTS and Crucibles; Melting Pots.—W. J. Warner, 1635.

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SHOT, Shell, Bullets, &c.—W. Palliser, 1681.

SHUTTLES.—T. M. Palmer and C. A. Shaw, 1655. M. Benson (com.), 1795. A. M. Clark (com.), 1834. A. M. Clark (com.), 1858.

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SIGNALS, Alarms, Conmunicating Apparatus, Conveying Sounds.—J. Pintsche and J. Schulke, 1623. G. Zanini, 1677. W. Clarke (com.), 1766. T. Eldershaw, 1775. B. R. Jackson and W. Winwood, 1893. P. Ayers, 1959.

SLABS.—H. Gardner (com.), 1845.

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SPADES, Shovels, &c.—W. Armistead and J. Morley, 1694. D. Yardley. 1984. J. Lee, 1996.

SPINNING and Preparing for Spinning.—A. M. Clark (com.), 1643. W. H. Oates and C. Pearson, 1653. J. and S. Hainsworth and C. Pearson, 1743. C. Duffield and J. Best, 1777. J. Aimers, 1836. A. C. Henderson (com.), 1869. J. Ross, and C. Pearson, 1900. J. Greenwood and J. Thornely, 1905. J. Clapham, 1942. E. G. Brewer (com.), 1945. W. Stannard, 1950. E. Hubner, 1956. J. Taylor and G. T. Rawlings, 1967.

STEAM and other Boilers, Cleaning and Preventing Incrustation of Boilers, Water Feeding Apparatus for Boilers.—W. Morgan-Brown (com.), 1637. R. Cosslett, 1692. F. de Valuzenay, 1765. J. Napier, 1826. J. S. Stubbs, 1846. J. Fagan, 1852. G. Plant, 1940.

STEAM Engines (Stationary, Locomotive, and Marine.)—J. Evans, 1711. J. Fleming (com.), 1759. W. T. Clark, 1809. J. C. Thompson, 1835. W. Rennie, 1843. A. F. Caron and E. Julien, 1862. W. P. Martin, 1896. A. M. Clark (com.), 1943. A. P. Price (com.), 1916. C. W. King and A. Cliff, 1963. E. A. Brydges (com.), 1985. W. M. Newton, 1994. W. R. Lake (com.), 1998.

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STRAPS.—F. H. and F. Dowler, 1806.

STUFFING Boxes, Glands.—J. Fleming (com.), 1759.

SUGAR and Syrups, &c.—C. D. Abel (com.), 1624. W. R. Lake (com.), 1703. W. R. Lake (com.), 1706. J. F. C. Farquhar and J. B. Macfarlane, 1904.

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TENTS, &c.—C. H. Leycester, 1689. C. H. Tollett, 1877. C. H. Leycester, 1936.

THERMOMETERS, Barometers, Pyrometers.—L. Peroni, 1879.

THRASHING Machines.—R. R. Holben, 1913.

TOBACCO and Snuff, Cigars, Cigar-holders, Pipe and Cigar-lighters, Smoking-pipes, Tobacco-pouches.—B. J. Mills (com.), 1751. L. Chaix, 1849.

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TORPEDOES.—G. W. Garrett, 1838.

TRAMWAYS and Tramway Carriages, Tramway Locomotives.—J. J. Halcombe, 1616. F. W. Eox, E. Walker, and E. Perrett, 1620. H. A. Silver, 1817. J. Hight, 1890. A. M. Clark (com.), 1892. A. P. Price (com.), 1916. W. M. Newton, 1994.

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VALVES, Taps, Stop Cocks, Plugs; Regulating the Flow and Pressure of Fluids.—G. W. von Nawrocki (com.), 1697. J. Evans, 1711. F. H. F. Engel (com.), 1714. E. R. Coerie, 1787. S. Grafton, 1804. W. T. Clark, 1809. G. R. Ashworth, 1844. G. Arundel, 1859. W. P. Martin, 1896. J. Anderson, 1902. A. M. Clark (com.), 1934.

VASES, &c.—W. H. Lloyd, 1871. A. P. Price (com.), 1938.

VELOCIPEDES, Bicycles.—H. C. Wood and T. Fenelon, 1658. H. and C. Renard, 1725. F. Agnew, J. Walker, and S. Dorset, 1808. M. M. Brophy, 1953.

VENTILATION; Supplying and Purifying Air for Buildings, Mines, Ships, Carriages, &c.—W. D. A. Mann, 1718. J. Boag, 1837. J. Beattie, 1978. A. Heegaard, 1989.

WASHING, Cleansing, and Wringing Fabrics, Yarns, and Materials.—C. Greenwood and A. B. Crossley, 1712. J. Hight, 1839. A. C. Henderson (com.), 1899.

WATERCLOSETS, &c.—J. Anderson, 1902.

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WATERPROOFING, &c.—D. Johnson, 1832.

WEARING Apparel for Gentlemen, Military Outfits, &c.—J. Warshawsky, 1647. R. R. Gadsden, 1818. D. Johnson, 1832. W. H. Sladdin, 2006.

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WHEELS for Carriages, &c.—H. A. Bonneville (com.), 1700. J. Smith, 1797. F. Haseldine, 1799.

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WINDOW Blinds, &c.—W. J. E. Henley, 1807. W. Shirley, 1947. G. D. Peters, 2016.

WINDOWS and Sashes, &c.—N. Mackay, 1645. W. R. Lake (com.), 1727. W. R. Lake (com.), 1812. E. Verrall, 1911.

WIRE-WORKING, Wire Ropes, Telegraph Cables.—W. R. Lake (com.), 1625. W. Abbott, 1937. P. Ayers, 1959.

WOODS and Veneers, &c.—J. Budd, 1755. A. Ford, 2002.

YEAST.—M. M. Prager, 1855.

Reviews.

SCIENCE FOR ALL.

"Science for All." Cassell, Petter, and Galpin, London, Paris, and New York.

THIS serial, now issuing by the above-mentioned publishers, is equal in importance and value to anything ever issued by them —and this is saying a great deal. We may cite the following in support of our high opinion of the work:—

COMMON OPTICAL ILLUSIONS.

"Every boy is familiar with the experiment of making a ring of fire in the air by swinging round the red-hot end of a burning stick. The luminous ring so formed is obviously an illusion, for it is clear that the light from the incandescent point can come from only one position in its path at any one time. It cannot be at the same instant at both ends of the circle, and yet the eye can detect no break in the continuity of its path. This experiment is a simple and characteristic illustration of a large class of optical illusions, which result from a very necessary property of vision, which is called the 'persistence of visual impressions on the retina'—that is to say, an object placed before the eye and suddenly removed is seen for a certain appreciable time after its removal. This persistence of the image on the retina—or, what is, for practical purposes the same thing, the impression on the brain of a persistent image—facilitates the exercise of sight; it gives time to the mind to take in the message, and to interpret its meaning. Were it not for this property, the eye in the act of reading would be compelled to rest for a longer period on each word to enable the mind to understand it, and by the necessary and involuntary act of winking the eye would be plunged into darkness at every few seconds. The time that this impression lasts has been variously estimated at from the sixth to the eleventh part of a second, but it is very generally regarded as about one-eighth of a second. The explanation, therefore, of the luminous ring formed by a lighted stick is that the impression made by it at any one point of its course remains on the retina until it again reaches that point. For the same reason a vibrating string, such as that of a harp, or other musical instrument, appears as a flat transparent film filling up the space included between the two extremes of its amplitude of vibration. Similarly a red-hot cannon-ball fired at night appears like a long line of light or as a luminous stick travelling through the air in the direction of its length. Were it not for this phenomenon of vision, some of the chief attractions of fireworks would be lost altogether; the rocket would have no fiery train, the catherine-wheel would exhibit but a shower of sparks, and the larger revolving 'set pieces' would be but slightly more attractive."

GREAT INDUSTRIES OF GREAT BRITAIN.

"Great Industries of Great Britain." Cassell, Petter, and Galpin, London, Paris, and New York.

UNDER the above title Messrs. Cassell issue a serial which ably and exhaustively describes various prominent branches of manufacture practised in this country. Where everything is good it is difficult to hit upon any particular passage as being more worthy of quotation than any other. Perhaps the following may be as good a sample of the comprehensive character of the work, which is no mere dry description of processes and mechanism backed up by statistical ,details, but is a full account of everything of importance connected with the industry under consideration, as we think the ensuing quotation will tend to convince anyone:—

ACCIDENTS IN BLAST FURNACES.

"It may be interesting to the reader to know something about the causes of explosions that sometimes occur in blast furnaces, accounts of which, under the heading of 'Accident,' not unfrequently appear in the newspapers, and which are generally accompanied with much suffering to the injured, from the molten iron being scattered about in all directions. It has been explained that the hot blast from the blowing engines is conveyed in pipes to the bottom of the blast furnace, and that it is directed upon its seething contents by means of a nozzle called a 'tuyere.' In order to protect these nozzles from the intense heat, which would very soon melt them away, they are surrounded by cold water, which is kept in constant circulation, and which renders them comparatively cool. Almost all the explosions that have ever taken place in blast furnaces are traceable to a leak in this circulating apparatus, which allows water to be injected into the furnace along with the blast, and leads to such a sudden development of steam that an explosion follows, often throwing out great masses of molten iron and cinders, and destroying any unfortunate workmen who may happen to be in the way. It appears, however. that leaky nozzles are so common, that if the mere injection of water into a blast furnace were invariably followed by an explosion such accidents would be much more frequent than they really are. This has led some ironmasters to conclude that it is not the presence of water but the wet surface of a nozzle which has melted off and fallen into the molten metal, that causes an explosion; for experience has proved that a little scrap of wet iron, if forced among a molten mass, will be sufficient to cause a greater catastrophe than water. It is this fact that makes plumbers so cautious when they are pouring molten lead into a recess. Any moisture on the surface that comes in contact with the metal is converted into steam so instantaneously, that carelessness not unfrequently entails upon the artisan the penalty of loss of eyesight from the effects of the explosion. In blast furnaces accidents sometimes arise from explosive gases getting into the pipes which lead from the furnace to the blowing engines, and these create immense damage when they are exploded by ignition."

The work, besides giving full accounts of our great industries, gives biographies of eminent manufacturers, the biography of Henry Bessemer, Esq., being given in a recent number.

WHOLE MEAL BREAD.

"The Whole-meal Bread Question in a Dietetic and Economic Point of View; with a Sketch of Bakers and Baking, Past and Present." London: W. Hill and Son (Bakers to the Queen), and T. C. Heawood, 26, Paternoster-square, E.C.

ALTHOUGH this is a trade pamphlet, we consider it worthy of favourable notice, because the subject it refers to is one of the very highest importance, and the fact that Messrs. Hill and Son, who are of high reputation as bakers, have taken up with the making and vending of whole meal bread (which, by the bye, if we are not mistaken, was energetically advocated years ago by Mr. W. H. Hart), shows that the matter is not one of the chimeras of an inventive brain, but a thing which belongs to the practical realities of life.

In the preface Messrs. W. Hill and Son state that, having devoted a considerable portion of their capital and some years of careful study, with the view of perfecting the manufacture of whole meal bread and biscuits, believe that they have attained that object, and in consequence they are now enabled to offer the most wholesome and nutritious loaf, as well as the best and most palatable form of biscuits, which have yet been manufactured. They therefore place them before the public, in full confidence that the great superiority of their whole meal productions, in a dietetic and medicinal point of view, will commend them to universal use.

They recently invited a number of eminent physicians, medical officers of health, public analysts, authors, journalists, and other representative men to test critically the relative value of their special productions, and subsequently to meet and compare notes. And amongst those who attended, we may mention two names well known to many of our readers, Dr. Hardwicke and Dr. Bartlett.

This little work is the outcome of that gathering, inasmuch as it contains the discussion and speeches that were made on that occasion, taken verbatim by two gentlemen from the "gallery of the House," who kindly consented to act as "our own reporters." It contains in addition a slight sketch of the baking trade in times past and present, from the pen of a practiced writer.

Messrs. Hill and Son prefer, therefore, to address the public in the words of skilled experts on the question of food supply and nutriment, rather than advocate the merits of their own productions. They only add that, with one or two exceptions, all the gentlemen who attended the meeting were personally unknown to them. Messrs. Hill and Son state that they purposely avoided asking the attendance of their own friends in order that a thoroughly impartial and disinterested verdict should be obtained.

That verdict is now in the hands of the reader of this pamphlet.

That this little work is not a mere dry disquisition, on a medical and sanitary question, we may just state that, *inter alia*, it contains statements as to the early history of bakery, the legends concerning the White Bakers' Company, reference to *Hollingshead's Chronicle*; restriction on the sale of bread, and on the bakers' trade, with medical opinions on the value of brown bread, by Drs. Pavy, Parkes, Bartlett, Church, Hardwicke, Tripe and Fothergill.

Incidentally, some gossiping writing i indulged in with regard to Bartholomew Fair and the Flying Pieman, Tiddy Doll, and the Hot Gingerbread man. Interspersed are some engravings, taken from old prints.

Altogether, this brochure is a pleasant readable essay on a matter worthy of the most earnest attention.

THE PHONOGRAPH.

"Edison's Talking Phonograph: its Construction, its Present Capabilities, its Future Possibilities." London: E. J. Davey, Boy-court, Ludgate-hill, E.C. 1878.

THIS sixpenny pamphlet contains a readable and explicit treatise on Edison's phonograph, a full account of which will be found in another column.

A CITY SLIDING DOWN HILL.—The Virginia (Nev.) *Enterprise* says: "Our town is very quietly moving to the eastward down the face of the mountain. This is owing to the settling of the ground over the Bonanza mines. As all the town is going together it is not much noticed on the surface, where no cracks are seen. The water and gas companies are better acquainted with the movements taking place in the ground forming the site of the town than most others, as the instability of tae earth tells upon their pipes.

MANGANESE IN THE BLOOD.— Richet has executed some quantitative determinations of this element by incinerating lare quantities of blood, or destroying its organic constituents with chlorine, and then precipitating the manganese in the form of dioxide by the galvanic current. He regards its presence as accidental, not normal.

TELEPHONIC PROGRESS.

THE PHONOGRAPH AND THE MICROPHONE.

Electricity seems to be working wonders apace. No sooner have we heard, seen, and handled the Telephone than we are presented with another instrument of still greater capabilities, inasmuch as it can (so to speak) not merely transmit sounds and talk to the ends of the earth, but can act as recorder of same. Still more recently we have had the Microphone brought before us, which much excels the two former instruments in the acuteness of its action, so far indeed that the slightest sound seems to be capable of transmission by its aid.

The phonograph—the origination of which is accredited to Mr. Thomas A. Edison—like the telephone, depends upon the use of a vibrating plate, and a wire or line of communication, aided by the use of electrical power; but it differs in some important particulars from that instrument. As described in a pamphlet briefly noticed in another column, the phonograph consists of a cylinder, F, turning on an axle which passes through the two standards, A and B. On one end of this axle is the crank, D; on the other the fly-wheel, E. The portion of this axle to the right of the cylinder has a screw-thread cut on it, which, working in a nut, A, causes the cylinder to move laterally when the crank is turned. On the surface of the cylinder is scored the same thread as on its axle. At F (shown in half-scale in Fig. 2) is a plate of iron, A, about 1-100th of an inch thick. This plate can be moved to and from the cylinder by pushing in or pulling out the lever, H G, which turns in a horizontal plane around pin I.

The under side of this thin iron plate, A (Fig. 2), presses against short pieces of rubber tubing, X and X, which lie between the plate and a spring attached to E. The end of this spring carries a rounded steel point, P, which enters slightly between threads scored on the cylinder C. The distance of this point, P, from the cylinder is regulated by a set-screw, S, against which abuts the lever, H G.

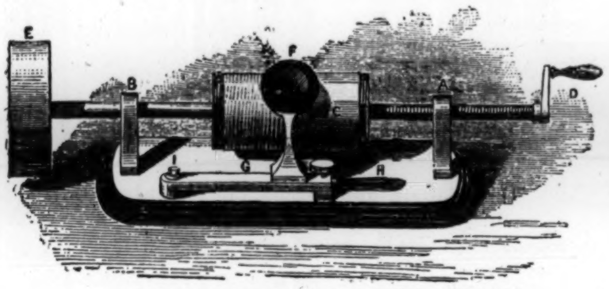

Fig. 1.—Edison's Talking Phonograph.

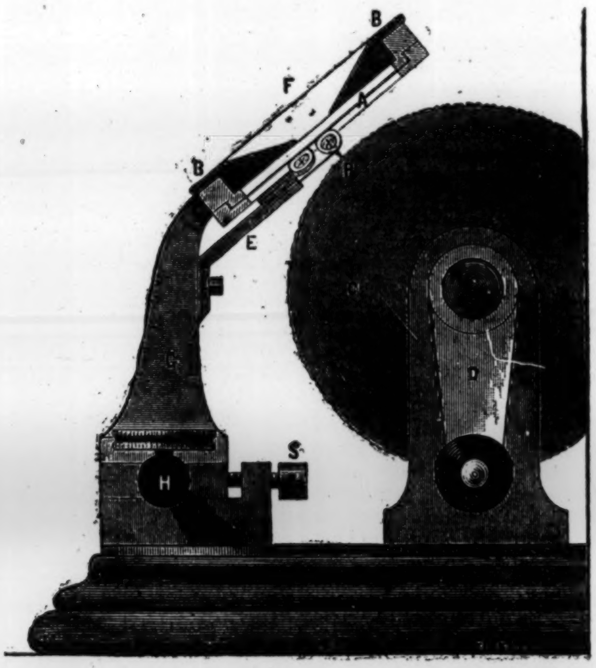

Fig. 2.

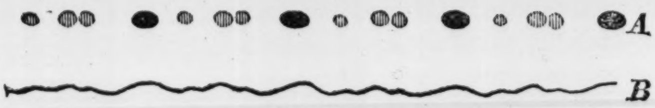

Fig. 3.

Over the iron plate, A, is a disk of vulcanite, B B, with a hole in its centre. The under side of this disk nearly touches the plate A. Its upper surface is cut into a shallow, funnel-shaped cavity, leading to the opening in its centre.

To work the Phonograph, the cylinder is neatly coated with a sheet of tin-foil, made to adhere by gumming the corners; then we bring the point, P, to bear against this foil, so that, on turntng the cylinder, it makes a depressed line, or furrow. The mouth is now placed close to the opening in the vulcanite disk, B B, and *the metal plate is talked to*, while the cylinder is revolved with a uniform motion.

When sounds are uttered close to the plate, A, it vibrates to the voice, and the point, P, indents the foil, impressing in it the varying numbers, amplitudes, and durations of these vibrations. If the vibrations given by the voice are those causing simple sounds, and are of a uniform, regular character, then similar regular, undulating depressions are made in the foil. If the vibrations are those causing complex and irregular sounds (like those of the voice in speaking), then, similarly, the depressions made in the foil are complex, having profiles like the curve, B, in Fig 3. Thus the foil receives and *retains* the mechanical impressions of these vibrations, with all their minute and subtile characteristics.

The permanent impressions of the vibration of the voice are now made. It remains *to obtain from these impressions the aerial vibrations which made them.* To accomplish this, the plate A, with its point P, is moved away from the cylinder by pulling towards you the lever H G. Then the motion of the cylinder is reversed till you have brought opposite to the point, P, the beginning of the series of impressions which it has made on the foil. Now bring the point up to the cylinder; place against the vulcanite plate, B B, a large cone of paper or tin to strengthen the sounds, and then steadily turn the crank D. The elevation and depressions which have been made by the point, P, now pass under this point, and, in so doing, they cause it and the thin iron plate to make over again the precise vibrations which animated them when they made these impressions under the action of the voice. The consequence of this is, that the iron plate gives out the vibrations which previously fell upon it, and it *talks back to you what you said to it.*

It is necessary to give to the cylinder a very regular motion of rotation while it receives and reproduces the vibrations made in singing; for even slight irregularities in the velocity of the cylinder destroy the accuracy of the musical intervals, and cause the Phonograph to sing falsetto. Even the reproducing of speech is greatly improved by rotating the cylinder by clockwork mechanism, which gives it uniformity of motion. If you make the machine talk by giving it a more rapid rotation than it had when you spoke to it, the pitch of its voice is raised; and by varying the velocity of the cylinder the machine may be made to speak the same sentence in a very bass voice, or in a voice of a pitch so high that its sounds are really elfish and entirely unnatural.

Mr. Edison's experiments have led him to conclude—

That the size of the hole through which you speak has a good deal to do with the articulation. When words are spoken against the whole diphragm, the hissing sounds, as in *shall*, *fleece*, *last*, are lost; whereas, by the use of a small hole, provided with sharp edges, these words are reinforced and recorded. Also, teeth around the edge of a slot, instead of a round hole, give the hissing consonants clearer.

That the best reading is obtained when the mouthpiece, B F B (Fig 2), is covered with several thicknesses of cloth, so that the snapping noise on the foil is rendered less audible.

It is obvious that such an instrument as that described, must be deemed a scientific wonder. What then must we say of Professor Hughes' invention—the Microphone? This, like the Phonograph, is a further development of the Telephone; the origination and character of the invention being described by Professor Hughes, at the Royal Society, as due to his having employed that instrument for various acoustic experiments. Having a stretched wire on his telephonic circuit, though he talked and plucked at it, no effect followed until it broke. At that moment the telephone uttered a sort of "shh," which was very curious. He placed the broken ends together under a weight, and obtained faint sounds, which were improved when the wires were connected by iron nails, or a steel watch-chain—the more pieces and more diverse in substance from the conductor seemingly the better. Experimenting still further with his broken circuit, especially in the direction of this whisper from Science about "More pieces," he found metallic powder or fine metal filings wonderfully augment the power of transmitting sounds; while shot in a bright condition, platinum, carbon, and mercury also gave good results, particularly the last. Following up this clue, Professor Hughes hit upon a plan of suspending finely divided mercury in a stick of charcoal by heating the latter and plunging it into quicksilver, whereupon the charcoal becomes infiltrated with the mercury in minutest but continuous particles. Inserting a "transmitter" of this sort in his circuit, an absolutely amazing sensitiveness to sound, as well as power of conveying it with the utmost fidelity, was displayed by the apparatus. A touch of the finger on the vibrating plate was conducted to the speaking end in volume of vibration like the rustle of a forest; the stroking of a camel's-hair brush on a card was magnified into the sound of a loud whisper; the beating of a pulse, or the tick of a watch was found to pass with perfect clearness through a resistance representing a hundred miles of space: and, when a fly happened to walk over the plate, the tramp of its feet was most distinctly caught like that of some six-legged horse trotting, and it was, moreover, heard to trumpet from its raised proboscis like an elephant in an Indian jungle. Sounds, in fact, totally inaudible before to human ears were arrested and reported by this simple and accidental expedient of interrupting the electrical circuit with a finely-divided conducting material. There seems little doubt that the perfected Microphone will convey to us that hidden ripple of the sap rising in growing trees and plants which Humboldt said might be a continuous melody in the auditory organs of earth's smallest creatures. The "music of the spheres"—if we could only find a way of localising the vibrations of a star, as we can isolate and examine its light with the spectroscope—would possibly become sensible to us. It may be expected to replace the clumsy methods of the stethoscope and sphymograph with a most accurate appliance, which will tell the doctor's ear exactly what the heart and the pulse have to say about his patient's case. Some application of it, by properly employing a little portable battery and circuit, may probably be hit upon, which will greatly alleviate, or even wholly remove, the disabilities of the deaf. But, more than this, while magnifying audible sound, and reporting to us tones which were before inaudible, this new invention is said to solve all difficulties as to articulateness in telephonic transmission. It conveys speech, or music, or the slightest inflections of accent and *timbre*, with perfect distinctness, and with a power so complete that it increases indefinitely that which the telephone has exhibited with a homogeneous conducting wire.

DAVIES'S PATENT QUICK SPEED STEERING APPARATUS FOR STEAM AND SAILING VESSELS.

THE invention above mentioned, which formed the subject of a paper read at the meeting of the Inventors' Institute, 7th May, 1878, relates to an appliance designed to meet—in some measure—one of the most pressing wants of the day, viz., "A means whereby the number of collisions may be reduced." The tenor of Mr. Davies's paper was this:—Life and death often depends on a quick helm; and yet the power at the wheel (where steam is not used) is seldom more that what is required for ordinary sailing.

Under these circumstances it is very desirable to have an efficient auxiliary power of some kind—so as to give greater safety to life and property at sea.

The saving of two or three seconds of time in turning a ship's head from approaching danger cannot be over estimated.

The apparatus submitted to notice may be fairly regarded as an "auxiliary," its power depending on the motion of the vessel through the water. It is connected to the steering gear in such a way as to be constantly exerting pressure on the tiller. A cylinder is provided, having a spiral spring in it—pressed up by piston and rod. The heel of the cylinder is hinged on a pivot attached to the deck, a connecting rod being fixed to a stud in lower side of tiller; at this point the resistance of the spring (in practice) is about 45 cwts; when the helmsman, with his wheel and purchase gear (which may be of any kind now in use), puts the tiller say hard over, the spring, being elastic, will assist him, the thrust at this point being about 15 cwts.

In the next move—say from the latter point back to keel line—the spring will be pressed in by a portion of the "force of the water" on the surface of the rudder, up to a few degrees of the keel line—when a slight pressure on the steering wheel will suffice to put the tiller amidships, where the spring is again ready to thrust the tiller over to port, or starboard, and so on, alternately.

Mr. Davies's paper was accompanied by the exhibition and exposition of a photograph and detail engravings, several figures showing another method of utilising water force for purposes just named; but as these plans are only suited to vessels moving in "smooth" waters, comment is needless.

The photo exhibited was taken from a model, and showed a compact mode of applying the patent gear. In this case, the tiller is of a novel description, being bent at the end, so as to carry the steering chains around the leading block, which is placed over the keel line. It is a substitute for a quadrant tiller, and it is claimed for this that it answers the purpose well and is about two-thirds less costly. The cylinder differs from that above described, and is the same as those intended for general use. The handle on the side, if turned from left to right (when the tiller is amidships), will drive a bolt inwards, which will prevent the piston from running out, and in order to provide for the freedom of the tiller when the pressure is thus taken off, either for docking or going astern, the end of the piston rod has on it a long link, wherein the thrust stud plays freely, and causes the cylinder to oscillate in the same manner as when the pressure is on.

The paper proceeded to state that the apparatus has been fitted on two new sailing vessels (each 1,100 tons), now on an Australian voyage, and in course of time such reports of its performance are expected as will either establish its utility or suggest improvements as may lead to its being made more perfect.

The attention of the marine public in Liverpool was drawn to the apparatus when the above vessels were loading, and opinions were very freely expressed in favour of the invention as a promising and much needed appliance. There is reason to believe that the estimated advantages can be fully realised; and that it can be made worthy of a place on the "Board of Trade's" list of those indispensables for steam and sailing vessels which are intended to contribute to the safety of human life.

Upon the conclusion of the paper, a discussion ensued, in which the chairman of the evening, F. H. Varley, Esq., C.E, Chairman E.C.I.I., Dr. I. McGrigor Croft, sen., M.E.C.I.I., and Messrs. S. Calley and A. J. Murray, took part, the result being that a favourable view of the invention prevailed, and regret was expressed that owing to experimental models or specimens not being brought before the meeting, a more decided expression of opinion could not be given. A vote of thanks to Mr. Davies for his communication was passed unanimously.

FOREIGN SCIENCE.

Our old friend *Les Mondes* promises to narrate after the best fashion the marvels of the Great Exhibition, and to seek out novelty, inventions, and unheard-of and actual discoveries. It thinks that a better plan would have been to reunite in the finest hall of the palace of industry everything of a character partaking of originality and novelty—everything which had not yet figured elsewhere. The following is interesting about inventors:—"People have in these recent years attached so much indifference, disdain, and injustice to inventors—who are placed by certain theorists in the rank of enemies of industry and commerce—that we take every opportunity of avenging them. Truly new and fruitful perfectionations are what we shall seek above everything in the collections of the Champs de Mars and the Trocadero, and to which we will open our pages largely. We conjure them to come to us, if we do not go to them and theirs. We will testify great gratitude to the friends of progress who will help us in discovering them. Invention and inventions are necessary to us. We will give them the place of honour; we will advise them, and will present them to be admired after our best efforts."

The late Father Secchi contributed very efficaciously to the rapid progress made by meteorology in Italy during the last years. In 1862 he began the publication of the "Bolletino Meteorologico" of the Observatory of the Roman College, in which he gathered numerous and important facts relative to meteorology. The meteorological service was inaugurated in Italy in 1865 by Louis Torelli. The Meteorological Observatory of Stelvio, founded in 1872 by the section of Valteline, of the Alpine Club, is probably to be dedicated to Father Secchi. It is a singular and important observatory. It and that of Colonel de Valdoobia are at present the two very elevated sentinels exploring not only the atmosphere of Italy, but also that of the whole of Europe. It is besides the first *avant poste* which meteorology has in the north of Italy, and it surveys the much frequented meteorological passages which conduct from Switzerland to Austria in Italy. The station of Stilvio is a *résumé* of the meteorology of Europe. The stranger on first entrance to Italy by this elevated and distant passage, on encountering the first inhabited place, will immediately salute the immortal name of R. Secchi; and in the silence of snow and glaciers can visit his works in the library; also those of the Bureau Central de Meteorologie Italienne and the Correspondance Meteorologique, Alpine-Apennine.

For Telephones iron plates do not appear to be absolutely necessary, although iron acts better than anything else, and dia-magnetic subjects also act well. A *savant* writes:—"Desiring my assistant, who was at some distance, and could not in any way perceive a direct sound, should continue to count for some time, I took away the iron plate and placed a large iron bar across the instrument 1·1 inch in thickness. On placing my ear against it, I heard every number distinctly, but rather weakened. A square piece of brass, of 3·3 inches, was put in its place; the sound, although distant, was not as strong as on the preceding occasion. Thick pieces of lead, zinc, and brass were tried turn by turn. Steel acted almost like iron, and as in the other cases every word pronounced was feebly but distinctly heard Some of these metals were diamagnetic, and nevertheless action was produced.

The Italian Government, according to a recent magazine, have been considering the best way of defending their coast. It has proposed to employ torpedoes and ships of war principally, and to construct fortifications, which, if the intention be carried out, will give employment to a number of people They seem to be over convinced about the value and merits of *torpilles.*

Some very thoroughly scientific and statistical accounts of the French and English navies have appeared in last month's French magazines, the "Annales Industrielles," we believe, amongst others. The French appear to be in a state of organisation somewhat similar to our own The expenses of maintenance are given in detail. The "Swiss Magazine" has had some good articles on scientific subjects lately.

THE DECLINE OF THE IRONCLAD.

THERE is something which forcibly reminds one of the ancient question of the irresistible force and immovable body, in the modern futile search for impregnable ironclads and unopposable guns. A recent writer in the *Revue des Deux Mondes* very pertinently compares the naval engineering of the present day to the quest for the absolute which occupied mediæval astrologers, for in both cases, as fast as progress is made, new possibilities and new necessities seem apparent, until above all rises the obvious impossibility of predicting when the desired goal shall be reached. Neither can the colossal outlay of money and time expended in attempts toward the solution of the problem of guns and armour be said to have afforded other than merely negative results. Great Britain has paid millions to discover that certain armour is not impregnable, or the converse that certain guns are not irresistible, and at the present moment a leading British engineering journal candidly avows that the total result of all experience in armour plating has reduced itself to the quandary of whether it is better to use steel armour, which will resist penetration, but which will be quickly shivered by the projectiles, or iron armour, which will not split, but will be pierced. In the matter of guns, which now are in advance, it would seem that the limit of the size to which they can be increased must soon be fixed by the capacity of vessels to withstand the concussion and shock of their discharge. The heavier vessels are armoured the stiffer they are, the less elastic, and consequently the more liable to injury by racking strain; to gain elasticity by reducing armour is of course to lessen the protection.

So again, the whole question of constructing armoured vessels is about as unsettled as it very well can be. The Inflexible, supposed to combine in herself all the best expedients of advanced naval constructive skill, is a failure, and the verdict of an official board, translated into plain English, is, "Don't build another ship like her." Few concur in the proper mode of protecting a vessel. Some advocate unarmoured ends and heavily armoured citadel; some, heavily armoured ends and lightly armoured midship portion; some advise armour all over, even to far below the water line; some propose a mere belt; and so on in every variety.

If it were possible to cover a vessel all over with iron thick enough to stop the largest projectile, the problem would be easy to solve, but to do this is to render the ship unmanœuvrable. She would be like a shark that has to turn over to bite, and while the fish turns the intended victim escapes, or if injured, like an armoured knight of the olden time, who, when unhorsed, was at the mercy of his enemy, for his armour prevented his running away. In the Austro-Italian battle of Lissa, the ironclad Rè d'Italia became helpless from an injury to her rudder, and a wooden vessel, a mere transport hastily fitted up for action, rammed her and sent her to the bottom at a single blow. A more suggestive instance happened during the late Russo-Turkish war, in the splendid attack of the unarmoured Russian gunboat Vesta on one of the largest Turkish ironclads. The battle was fought at rifle range, and in a short time two of the Vesta's guns were dismounted, her rudder was jammed, and a fire near her magazine broke out, while the Turk poured in 15 inch and 7 inch shell as fast as his six guns could be worked. Just as the destruction of the Vesta seemed certain, a lucky shot from her alighted on the Turk's unprotected deck and struck his boilers, and with what steam the latter had left he ran away, the Vesta's injuries unfortunately preventing her following up her advantage.

Such instances as the above, besides the other considerations stated, are sufficient to show the inefficiency of heavy ironclads, without bringing torpedoes into the question at all; but as these terrible engines of war must play the chief part in all future naval conflicts, the disappearance of the heavy ironclad will be the almost certain consequence of their employment. At the time we write, the finest of England's fleets lies virtually at the mercy of torpedo attacks, and there is no concealment made of the anxiety occasioned thereby. The crews are kept constantly vigilant, guns are kept loaded, signal stations established, and every possible precaution taken in the face of the mere possibility that hostilitities may break out. It is openly doubted, if the Russians succeed in gathering the torpedo craft, planting the fixed torpedoes, and increasing their movable torpedo armament on the Dardanelles (which measures are known to be afoot), whether the English squadron can make its escape from the *cul de sac* in which it has placed itself. The Austro-Italian war, short as it was, showed the inefficiency of armoured vessels. In the Franco-Prussian war the French were unable to use them at all. The Russo-Turkish war has again shown their disadvantages; and an Anglo-Russian conflict, it would seem, can only furnish positive proof of what is already reasonably made certain.

Symptoms of reaction from the ideas which generated the modern ironclad are already visible. Far-sighted Germany, although recognizing the fact that her ironclads are no longer formidable compared with those of later date, refuses to build any more armoured vessels. For the protection of her coasts, light draft gunboats carrying large guns will be constructed, and her fleet, it is said, will be used for defensive purposes, never going into action at sea except when forced into it, or under specially favourable conditions. The days of such exploits as those of Farragut at New Orleans and Mobile are gone by, for torpedoes render them impossible. Invasions by fleets are obsolescent, and all signs indicate that the navy of the future will be such defensive gunboats as Germany contemplates, and light swift cruisers whose sole duty will be the destruction of an enemy's commerce.—*Scientific American.*

THE Turners' Company have issued a programme of the prizes offered by them in the present year for specimens of turnery. It can be obtained of the Hon. Secretary to Competition Committees, R. L. Loveland, Esq., 4, Hare-court, Temple, London, E.C.

INDUSTRY AND ART IN LONDON.

[BY A CORRESPONDENT.]

ASPHALTE. — This industry, which has had considerable success, is likely to have more, considering the "tendency" of house construction in the present day. There is a new Bill for regulating building, and one of its requirements is application of asphalte to floors for the sake of health. Here we may note that the above material is particularly adapted for roofing with iron girders, which can be used as open space for drying, &c. We may refer to the particular construction of new houses in London with flat roofs for playgrounds or drying spaces; also for a basement floor, as being a certain preventive of damp, vermin, and bad smells in basements of houses; for yards and playgrounds, being free from loose stones; and for lawn tennis, being always smooth and dry. Reference is made by the Granite Rock and Seyssel Asphalte Company, 57, Gracechurch-street, City, to work of many years' standing. Though the use of asphalte generally has much increased of late years, yet it is not much used beyond the roads and pavements near the sands of provincial watering-places; but there is now a great deal of side pavement being constructed in London, and its other uses are numerous. The applications besides those mentioned by the Granite Rock and Seyssel Asphalte are flats and terraces, foot pavements, barn floors, court yards, granaries, malthouses, coach-houses, dog-kennels, cow-sheds, carriage drives, stabling, piggeries, slaughter houses, railway platforms, warehouses, goods sheds, prison cells, racket courts, tennis courts, public footways, tun-room floors, conservatory ditto, lining of tanks, playgrounds, asylum floors, schoolroom ditto, washhouse ditto, barrack ditto.

LONDON DRAWING OFFICE.—This office is the only one of the kind, and from the explanation of the scheme of the undertaking, which we have received, appears likely to be of considerable assistance to architects, engineers, and other persons of the kind. It was established in the beginning of this year to supply the first-mentioned and others with a ready means of hoving drawings traced, tracings mounted, detail and working drawings made from rough sketches, and coloured or etched perspectives and elevations executed with expedition at the shortest notice. The manager for the London Drawing Office says:—"Every member of the profession well knows how vexatious it is in case of press of work to be obliged to engage fresh assistance at a moment's notice, and how time, temper, and money are wasted in the process." Arrangements have been made with some of the most eminent architectural artists, to whom, at special rates, high-class work in etching and in colour for photo-lithography competitions, &c., will be entrusted. Perspective drawings of buildings proposed to be built are made, drawn from the plans and elevations of the architects; and of actual buildings; also drawings for photolithography. The London Drawing Office is under the management of Mr. Edward H. Lloyd, 98, London Wall, E.C. Original work is also undertaken, that is to say, designs are supplied and buildings, &c., are carried out under the superintendence of the proprietors.

AN improved gate, patented by Mr. J. D. Hagaman, of Weston, Mich., is especially adapted to farm use, as its height is adjustable, so that the space between the lower part and the ground may be increased or diminished to allow passage of small stock or to clear obstructions of snow, ice, &c. This is accomplished by adding pivoted longitudinal bars and an adjusting lever.

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Established 1st May, 1862.

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President, SIR ANTONIO BRADY.

SESSION 1877—1878.

Members' Meeting.

On Thursday, June 6th, there will be no meeting; but on Thursday, June 27th, an Exposition of Inventions, and Conference on the New Patent Law Bill, if requisite.

Executive Council at half-past Seven on same evening.

Subscriptions are payable to Mr. G. A. Stretton, the Receiver, 4, St. Martin's-place, S.W., who is the proper official to give receipts. F. W. Campin, Sec.

Proceedings of the Institute.

EXECUTIVE COUNCILS.

On 9th May the Executive Council met, and after the minutes of the last meeting had been passed, and the finances reported upon by the Secretary, the position of Mr. Anderson's Patent Reform Bill was discussed; and it was decided that nothing could at present be done therein. It was resolved that twelve new names be recommended to the General Meeting for election as Members of the General Council. Also, that it was desirable to nominate some Honorary Members.

On 23rd May, precedent to the General Meeting, the Executive Council met, read over and approved their Annual Report (prepared by the Secretary) for presentation to the General Meeting. A draft Balance-sheet was submitted to the meeting, but as it was in some points incomplete, it was determined to suggest to the General Meeting the appointment of a Special Finance Committee to examine and pass same.

MEMBERS' MEETINGS.

On 9th May, Mr. Davies's Quick Speed Steering Apparatus was brought under consideration. This forms the subject of an article in another column. The Railway Key or Wedge, and the apparatus for manufacturing same, invented and patented by Messrs. Waddle, was again brought before the meeting, and seemed to elicit general approval.

The report of the proceedings at the Annual General Meeting, on 23rd May, will appear in our next issue.

Monthly Notices.

A Telephone without a Diaphragm is described in a pamphlet entitled "Sui Telefoni senza Lamine" by Prof. Francesco Rossetti, of the Academy of Sciences, Venice.

The Telephone as a Galvanoscope.—M. Berthelot presented to the Académie des Sciences, at a recent Séance, a note from M. d'Arsonval, showing that the telephone might be used as a galvanoscope, and that it formed one of the most delicate of those instruments known. Following Dubois-Reymond, he expressed his opinion that the telephone would furnish results in the study of animal electricity which could not be obtained by any other instrument.

The state of Vesuvius has lately created much anxiety amongst the immediate neighbours, and hopes amongst foreign visitors. All have been on the look-out for a great eruption, and have so tormented Prof. Palmieri with telegrams asking for information that he has at length issued a bill of health of the mountain. The new mouth, he says, which opened at the bottom of the crater in 1872, began to show menacing signs on the 18th of December, 1875, since which time it has been more or less active. On the 2nd inst., however, it gave indications of yet greater activity. The fire cannot be seen from Naples, as it is at the bottom of the crater, and only its reflection is visible on the smoke which rises from it. The smoke, which abounds with acids mingled with rain-water, is very injurious to vegetation, and in the direction of Ottaiano the vintage has been destroyed for nearly two years. The chances of a grand eruption still remain in uncertainty.—*Athenæum*.

The Zebra has been recommended, by the Manager of the Jardin d'Acclimatation at Paris, as a beast of burden better suited to African climate than any domesticated animals, not even excepting the ass. Several zebras, now under his charge, have been successfully broken in, and M. de Semellé, whose project of crossing Africa from the mouth of the Niger to the east coast has been referred to by us, may possibly make use of this novel beast of burden.

The late Mr. Alfred Smee, F.R.S.—Messrs. Bell have in the press, and will shortly publish, a biography of this gentleman, with a collection of his miscellaneous writings on scientific and social subjects. The volume is edited by his daughter, Mrs. Odling.

German Publications.—The "History of the Royal Opera at Berlin," under the direction of Freiherr von der Beck, and the "National Theatre up to Iffland's Time," by A. E. Brachvogel. This is the second volume of the author's history of the Royal Theatre at Berlin. The first volume of "Prince Bismarck's Political Life and Action," according to documents by Ludwig Hahn, for which the author has been thanked both by the Chancellor and the Emperor. Dr. H. von Poschinger's first part of the "History of the Banks in Prussia," from the remotest time to 1846. "Germany and Socialism," by Dr. Ludwig Bamberger, is partly a reprint from the *Deutsche Rundschau*. The "History of Painting," edited by Prof. Alfred Woltmann, of Prague, the first fasciculus of which has just been published, promises to be good. The editor writes the history of mediæval and modern art; the first part, comprising the ancient part, is by Prof. Karl Woermann, of Düsseldorf.

French Publications.—M. Rénan's "Caliban," reprinted from the *Temps*; "Les Nouveaux Satires et Exercices Gaillards d'Angot l'Eperonnière," edited with Notes by Prosper Blanchemin; "Guerre Franco-Allemande: Résumé et Commentaires de l'Ouvrage du Grand Etat-Major Prussien," by Capt. Félix Bonnet, of the French Artillery; the sixth part of the "Bibliothèque Musicale du Théatre de l'Opéra," an historical catalogue drawn up under the auspices of the Ministère de l'Instruction Publique, by Théodore de Lajarte: it deals with the days of Rossini and Meyerbeer; "La Roumanie: Géographie, Histoire, Organisation Politique," &c., by A. Beaure and H. Mathorel; "Lettres Inédites de Sismondi écrites pendant les Cent-jours," reprinted by P. Villari and G. Monod from the *Revue Historique*; "Atlas de l'Histoire de la Civilisation en Suède," by N. M. Mandelgren, fasciculi 1 and 2; "Dictionnaire du Jargon Parisien, l'Argot Ancien et l'Argot Moderne," by Lucien Rigaud; and "La Famille de Jeanne d'Arc, Documents Inédits, Généalogies, Lettres de J. Hordal et de Cl. du Lys à Ch. du Lys," now first printed, by E. de Bouteiller et G. de Braux.

TECHNICAL EDUCATION AND THE CITY GUILDS.

It is always more pleasant to praise than blame, and inclination tends to the former rather than the latter when we find persons that usually oppose the *vis inertiæ* of apathy to projects of progress and improvement becoming alive to the necessity of action, and moving forward in the right direction. In such case one is not disposed to be too criticising as to whether the forward motion is effected in the best style possible. Just this very feeling takes possession of us when considering the subject of Technical Education and the action of the City Guilds therein.

This subject, which has heretofore received much attention from us, is now prominently before the public, in consequence of the issue of a scheme which has just been elaborated by a Committee appointed by twelve Livery Companies, including those of the Mercers, Drapers, Fishmongers, Goldsmiths, and Clothworkers, in conjunction with six gentlemen, stated by our contemporary "The Times" (from whom we quote) to be qualified either as employers of labour or conversance with pure Science or Technical Education.

This scheme begins most correctly, for it lays down as the end and object of the movement "the improvement of the technical knowledge of those engaged in the manufactures of this country, whether employed as workmen, managers, or foremen, or as principals," and that this improvement in technical knowledge would not be promoted by teaching the workman greater expertness in his handicraft. The companies need not be at the expense of setting up a model manufactory or workshop; what they should teach is, not how the blast furnaceman should manipulate his furnace, but why, for instance, pig-iron is sometimes unsaleable except at a reduced price. The workman must learn elsewhere how to handle his tools. The training the City Companies will provide must be of a nature to impart a knowledge of the scientific or artistic principles upon which the particular manufacture may depend. This education, the Executive Committee believe, can be best furnished through the double apparatus of a central institution in London and local trade schools in different districts. No one should be admitted to the central institution except on proof of such knowledge of Science and Art as would enable him to profit by the instruction it would furnish. What this instruction is to be may be gathered from the Committee's recommendation that the course of studies should comprise Applied Physics, with a professor, demonstrator, and assistant; Applied Chemistry, with a similar staff; Applied Mechanics, with a professor, a demonstrator for mathematics, a demonstrator for mechanical drawing, and an assistant; and an Applied Art Department, with a superintendent or professor, and assistants for the several classes. The Executive Committee calculates that this teaching apparatus would cost £10,000 a year; but that sum includes £1000 for the rent of temporary buildings. In course of time a permanent house might be provided at a computed outlay ef £30,000. The Committee appears to agree with a warning of Professor Huxley's, that regard should be had to what is wanted in the inside, and not to what will look well from the outside. Convenient lecture-rooms are obviously a primary necessity; but we hope the wealthy guilds of London will not be misled by this advice into deforming the City by lodging Science worse than an Insurance Company or a Bank. Besides the annual £10,000 required to support and temporarily lodge the Central College, the Committee asks and expects to receive from the Livery Companies a second £10,000 to endow exhibitions for meritorious students, tenable at the central institution, to assist technical classes already established or to be hereafter established, to aid in equipping laboratories, and to provide apprenticeship premiums for promising boys, and prizes. Above all, out of the second £10,000 the Committee recommends that not less than £3000 be appropriated to the subsidising or institution of trade schools in London and the provincial centres of industry. Starting from this as a working basis, the Executive Committee believes that the Livery Companies, without submitting themselves to a scheme which experience might show to be erroneously conceived, would learn in what directions their efforts and resources could be best employed.

Some central authority and home of technical education is absolutely necessary, and this must obviously be located in London, which provides the whole of the funds. The only danger of the form in which the scheme elaborated by the Committee of the Livery Companies has fulfilled these primary conditions is that a College such as the Committee has designed may develope the theoretical at the expense of the practical side of education. The metropolis outside the City also possesses two Colleges which, as the report notices, have instituted technical classes. If the City itself within its narrow confines need others, it might have been supposed that Gresham College could have been utilised for the purpose. And we agree with our contemporary that the utmost care will have to be taken that the Central College does not develope or degenerate into a lecturing body for the benefit of City clerks and students of engineering, though on behalf of Inventors, who are drawn from every class, we would put in a plea for the comprehension of all classes. But this perhaps could be better met by subsidising such an Institution as the Birkbeck. The Committee are, perhaps, right in disavowing, on behalf of the companies, any duty to teach men how to handle their tools; but the instruction their intended College is to provide should be devised specially for the advantage of those whose province in life it is to handle tools or to see that they are properly handled. Science is to be admired and reverenced and pursued for its own sake; but in the Livery Companies' College it must condescend to a lower rank; it must become the handmaid of the spinning-jenny and the puddle-bar. The future governing body of any such "London Institute for the Advancement of Technical Education" will have no easy task in keeping their professors to their real province. If they do succeed, they will have achieved a remarkable triumph. And this we believe they will, if they strengthen themselves by full introduction of the practical element in every available position for it; and we look very hopefully to the prospects of the scheme so far as it contemplates the promotion of trade schools in London and the provinces. The Committee trust to the public spirit of residents in the localities to establish these schools in the first place, and then the City Companies might grant subventions. Only in the event of local lethargy does the Executive Committee recommend the foundation of two to serve as models. To such schools, more than to a staff of professors lecturing in the City on Applied Science, do we look for an improvement in art and industrial culture. The pupils, the Committee recommends, must show that they have already received elementary instruction in the principles of Science and Art, and the teachers must be selected from men who have a competent knowledge of the actual practice of particular trades, as well as of the scientific and artistic principles to be applied to them. Here we seem to have the proper admixture of the theoretical and the practical. Machinery is a bad master, but a good servant. A workman, in these days of mechanical triumphs, who does not understand and sympathise with the brains which have devised the instruments he tends becomes their drudge; but to the workman who bestows the same sort of intelligent appreciation on his steam horse that a mere groom does on a living horse it grows a source of continual education. Our readers may remember how, at the Philadelphia Exhibition, English implements lost ground from their roughness and the want of the loving care American workmen bestow on all the details of their products. A workman who loves his art will be punctilious as to details; but to love it he must know the principles on which it is based. Above all, what is wanted is that the English workman should *be fitted by technical education to co-operate with the English inventors* to whom we owe our wealth and commercial prosperity. If the London Livery Companies contribute by example as well as by pecuniary help to this end, they will have done much towards replacing themselves in the rank they had well-nigh forfeited by generations of ignoble indolence and luxury.

Proceedings of Societies.

ROYAL SOCIETY.

APRIL 4TH.—Sir J. Hooker, President, in the chair.—The following papers were read: "On the Development of the Parasitic Isopoda," by Mr. J. F. Butler; "On the Determination of the Constants of the Cup Anemometer," by the Rev. Dr. Robinson; "On the Action of Ozone on the Nuclei," by Mr. C. Tomlinson; "and "Notes on Physical Geology, No. IV. A Geological Proof that the Changes of Climate in Past Times were not due to Changes in the Position of the Pole, with an attempt to assign a Minor Limit to the Duration of Geological Time," by the Rev. Dr. Haughton.

APRIL 11TH.—Dr. W. Farr, V.P., in the chair.—Dr. C. McIntosh was admitted a Fellow. The following papers were read: "The Acceleration of Oxidation caused by the least Refrangible End of the Spectrum," by Capt. Abney; "Summary of an Experimental Inquiry into the Function of Respiration at various Altitudes," by Dr. Marcet; "On Stresses in Rarefied Gases arising from Inequalities of Temperature," by Mr. J. C. Maxwell; "Note on the Existence of Carbon in the Coronal Atmosphere of the Sun," by Mr. J. N. Lockyer; and "On the Physiological Action of the Poisonous Principle of *Urechites suberecta*," by Mr. J. J. Bowrey.

MAY 2ND.—Sir J. Hooker, President, in the chair.—The following papers were read: "On the Life-history of a Minute Septic Organism, with an account of Experiments made to determine the Thermal Death-point," by Rev. W. H. Dalinger,—"On the Reversal of the Lines of Metallic Vapours" (II.), by Profs. Liveing and Dewar,—"Preliminary Note on experiments in Electro-photometry," by Prof. Dewar,—and "On the Determination of the Scale Value of a Thomson's Quadrant Electrometer for Registering the Variations in Atmospheric Electricity at Kew Observatory," by G. M. Whipple.

ROYAL SOCIETY OF LITERATURE.

MARCH 27TH.—W. Knighton, Esq., in the chair.—Dr. Ingleby read a paper "On the Literary Career of a Shakespeare Forger." After a brief sketch of the origin and details of the Ireland forgeries, Dr. Ingleby discussed the question of their authorship, which, in December, 1855, had been reopened by Mr. Burn, who was then the editor of "Will's Current Notes." Mr. Burn attributed all the forgeries to the elder Ireland; but recently discovered evidence confirms the older view, that W. A. Ireland was the sole concocter and author of the hoax. Last summer the trustees of the British Museum purchased of a grandson of Samuel Ireland a mass of miscellaneous manuscripts bearing on these forgeries. These consist of three thick quarto volumes: 1, a scrap-book; 2, a volume of letters; 3, Samuel Ireland's Journal, besides other books, deeds, papers, &c. Dr. Ingleby stated that he had examined this collection, and found that its contents confirmed in every important particular the statements of W. H. Ireland in his "Authentic Account" and his "Confessions," and completely established the innocence of his father. Dr. Ingleby also exhibited sixteen volumes from his own library, being scarce tracts and other books of W. H. Ireland; also his MS. of the "Frogmore Fete," "Stanzas of Clara Fisher," "Monody on Shakespeare," his own copy of the "Authentic Account" with twenty-eight insertions of specimens or forgery, verses in the handwriting of his mother, and a fine crayon portrait of her; and a volume of letters and verses addressed to Samuel Ireland.

APRIL 24TH.—Dr. C. M. Ingleby and J. Haynes, Esq., successively in the chair. The President, H.R.H. the Prince Leopold, the Vice-Presidents, and the Council and Officers of last year were re-elected.

LINNEAN SOCIETY.

MARCH 21ST.—W. Carruthers, Esq., V.P., in the chair.—Mr. G. T. Saul exhibited an example of the enormous development of adventitious roots from a species of Berberis. On behalf of Mr. J. W. Clark, of Cambridge, there were exhibited mounted specimens of the male, female, and young of the Fur-bearing Seal of the North Pacific. Mention was made of the "rookeries" of these creatures, containing over three million seals in a compact area. Like old Turks, a male dominates over a harem of a dozen or fifteen females, which he guards with jealous care for two months or more without stirring from the spot, and meantime fights terrific battles for its maintenance. A neutral zone exists to the rear of the breeding-ground, where the enforced bachelors and adolescent young repair. These come and go continuously, passing to and fro through free lanes of passage. Others of these animals delight in dashing among the breakers on the surf, or in droves frolic and play on the sand and grassy dunes adjoining the more rocky ground of the "rookery." The method of shaving the fleshy side of the skin, thus cutting the roots of the long, coarse hairs, and retaining the superficial fine fur for commerce, was explained, as also other interesting points in the economy and natural history of the Otaries. The Secretary read the gist of a paper "On the Venation of the Leaf of Hemlock (*Conium maculatum*)," by Mr. J. Gorham. The latter's observations show that in a piece one-third of an inch long by one-fifth of an inch wide, by registration of the veinlets in a tabular form, and constructing these in figure, an exact counterpart of the venation of the entire leaf results. Comparisons of leaves of different umbelliferous genera prove that each can be detected and recognised from the merest fragment. A communication was made by Mr. B. Clarke, "On a new Arrangement of the Classes of Zoology," founded on the position of the oviducts, or, when these are absent, on the position of the ovaries, including a new mode of arranging the mammalia. A notice in abstract was given "On some Genera of the Olacaceæ," by Mr. J. Miers. The Rev. J. Berkeley and Mr. C. E. Broome gave a list of Fungi from Brisbane, Queensland. Among these Agarics, Clavariei, and fleshy fungi are scarce, interesting forms of Polyporei obtain, while leaf parasites are poorly represented. Some species are identical with Ceylon and South American kinds, and several are common to Europe.

APRIL 4TH.—W. Carruthers, V.P., in the chair.—Dr. A. Hewan, Messrs. F. M. Bailey, G. Payne, jun., and J. R. Reid were elected Fellows. There was exhibited by Dr. H. Trimen the base of the stem of the water-hemlock (*Cicuta virosa*, Linn.), in its floating winter state, obtained near Yarmouth. This was well figured in the "Philosophical Transactions" last century, but since has seldom been referred to by botanists. Mr. G. Murray showed under the microscope specimens of growing Saprolegnia, exhibiting terminal and interstitial oogonia. A paper, "On some Minute Hymenopterous Insects," by Prof. Westwood, was, in his absence, read by Mr. M'Lachlan. This contains descriptions of the following new forms: *Mymar Taprobanicus*, *M. Wollastonii*, *Alaptus excisus*, *Oligosita subfaciata*, *O. Stanforthii*, *O. nodicornis*, and *Trichogramma erosicornis*. All these singular insects are exceedingly interesting structurally, and as regards habits, &c. A short notice was made by Mr. M. C. Cooke, "On a Collection of Fungi from Texas made by Mr. Ravenel." Adding all other recorded species, the series shows that much yet remains unknown in the mycologic Flora of what is probably one of the richest States of the Union. The Secretary read some "Remarks on the peculiar Properties ascribed to a Fungus by the Samoans," by the Rev. T. Powell. The natives name the fungus Limamea, specimens of which have been forwarded to the Rev. M. Berkeley for identification. It destroys the bread-fruit trees and the chestnut (*Inocarpus edulis*). An antidote to its ravages is said to exist in the lilaceous plant, *Crinum Asiaticum*, which the natives plant between the trees liable to be affected.

MAY 2ND.—Dr. W. B. Carpenter, V.P., in the chair.—M. César Chambre and Mr. T. Comber were elected Fellows, and five Foreign Members to fill the annual vacancies were also elected.—Mr. J. R. Jackson exhibited specimens of fruits, leaves, and portions of the stem (used as a substitute for soap) illustrating peculiarities of *Yucca baccata*, Torrey. This plant extends from South Colorada far into Mexico. Northwards acaulescent, soathwards it developes a trunk ten feet high. The fruit, a dark purple berry, is preserved and eaten as winter provision, and the plant is commonly known as the Rocky Mountain Banana.—A note was read from the Rev. H. H. Higgins, concerning a large new Tubularin Hydrozoon (probably allied to Clava ?) from New Zealand.—On behalf of Mr. T. Higgin there was exhibited a photograph of *Chitina ericoposis*, Carter, as also microscopic specimens of this rare species of the Hydractiniidæ from New Zealand.—Mr. J. C. Galton called attention to a spined dermal plate of the Ray tribe of fisheries, mistaken for a fossil, and obtained near Barking Priory.—The Secretary read in abstract a paper "On Marupa, a Genus of the Simarubaceæ," by Mr. J. Miers. This is founded on a curious fruit and specimens of wood exhibited in the Brazilian department of the Paris Exhibition, 1857. Signor Netto in 1856 described a Brazilian plant, under the designation *Odina Francoana*, and bearing the vernacular name "Pao Pombo," as did the above-mentioned woods. Mr. Miers, however, is of opinion that Netto's species cannot belong to Odina, as that genus is Anacardiaceous, and quite foreign to the American continent. Then follows the technical characters of the new species, *Marupa Fraucoana* and *M. paraensis*.—A short paper was read by Mr. R. I. Lynch, "On the Seed Structure and Germination of a Species of Pachira." The seeds were received at Kew, July, 1877, and labelled the "Provision Tree." Varying in size, they consist chiefly of one fleshy-lobed cotyledon, the second being exceedingly diminutive and functionless. Germination occurs in a fortnight after sowing, and, in one instance, the larger persistent cotyledon did not appear to be exhausted for nearly six months.—The main facts of a detailed communication, "On the Occurrence of Conidial Fructification in the Mucorini, illustrated by Choanephora," by Dr. D. D. Cunningham, was, in the author's absence, read by the Secretary.

ROYAL INSTITUTION.

APRIL 1ST. — G. Busk, Esq., Treas. and V.P., in the chair.—Messrs. F. M. Campbell, A. W. Everest, L. F. Everest, C. C. Gooch, C. Hawksley, T. S. Jay, H. Parnell, and G. W. Smalley were elected members.

MAY 6TH.—Sir F. Pollock, Bart, M.A., V.P., in the chair. — The following *Vice-Presidents* for the ensuing year were announced:—Lord Lindsay, Dr. C. W. Siemens, and Sir F. Pollock, Bart.; G. Busk, *Treasurer;* W. Spottiswoode, *Secretary;* Messrs. P. Boyd, F. Crisp, J. M'Clelland, C. Mackenzie, and E. R. Merton were elected members.—Dr. J. Tyndall were re-elected Professor of Natural Philosophy.

SOCIETY OF ENGINEERS.

April 1st.—Mr. J. Bernays, V.P., in the chair.—A paper was read by Mr. W. Schönheyder, "On Equalising the Wear in Horizontal Steam Cylinders."

May 6th.—Mr. R. P. Spice, President, in the chair.—A paper was read by Mr. S. Copland, "On Modern Roadway Construction."

ANTHROPOLOGICAL INSTITUTE.

March 26th.—Mr. J. Evans, D.C.L., President, in the chair.—The following new members were announced: Dr. S. Evans and Dr. A. Thomson. A paper was read by Mr. F. Allen, "On the Original Range of the Papuan Race." This paper was a brief *résumé* of the opinions held by many anthropologists with regard to the origin, characteristics, and distribution of these races, and an attempt to prove that they once extended on the west as far as Africa and on the east as far as America. The writer especially dwelt upon the statements of Herodotus with regard to the Eastern and Western Ethiopians and the black Colchians, and referred to the legend of the Asiatic Memnon and the existence of black races in Central America within the historic period. The Director read a paper, by Dr. Julius Von Haast, "On some Ancient Rock Paintings in New Zealand." The author considered that when these rock paintings were carefully studied by archæologists and linguists they would prove that at one time there had been an introduction of a far higher civilization than the Maoris ever reached.

April 9th.—J. Evans, Esq., President, in the chair.—Dr. A. Thomson and Dr. S. Evans were admitted members. Mr. W. M. Flinders Petrie read a paper "On Inductive Metrology," the purpose of which, as explained by him, is to deduce the units of measure employed by ancient peoples from the dimensions of existing remains. Where units derived from several different buildings coincide a high probability of the accuracy of the resulting unit is obtained. This principle has been tested by application to the monuments existing among the peoples of the Mediterranean. Mr. Petrie had also applied it to the earthworks of this country. At Hill Devereux he had obtained a unit of 691 inches. At Steeple Langford a unit had been derived which varied only five inches. Near Orcheston is an earthwork forming a perfect ellipse. From this Mr. Petrie argued a considerable knowledge of mensuration on the part of the flint workers by whom it had been constructed. He urged the necessity of accurate measurement on the part of observers. Dr. E. B. Tylor read a paper "On the Game of Patolli in Ancient Mexico, and its probable Asiatic Origin." The game is a combination of dice and draughts. It was similar to a game called Putcheesi, in use in India, played by throwing cowries on to a board divided into squares of a certain pattern. So devoted are the natives to this game that a story is told of a provincial governor who habitually won back his servants' wages from them at it, and thus got served for nothing.

April 30th. — Major-General A. Lane Fox, V.P., in the chair.—Mr. F. Galton read a paper "On Composite Portraits, made by combining those of various Persons into a single Resultant Figure."—The Director read a paper by Mr. C. S. Wake "On the Origin of the Classificatory System of Relationships used among Primitive People."

PHYSICAL SOCIETY.

March 30th.—Prof. W. G. Adams, President, in the chair. The following candidates were elected members: Messrs. S. Bidwell, W. Grant, E. Gurney, and J. H. Smith. Mr. W. H. Preece described Byrne's Pneumatic Battery, and exhibited some of of the results that may be obtained by its means. Mr. Preece then exhibited an ingenious method of showing the vibrations of a telephone plate to an audience, which has been devised by Mr. H. Edmunds. Lord Rayleigh exhibited and explained an arrangement which he has employed with advantage in certain acoustical experiments in order to secure absolute uniformity in the rate of rotation of an axle.

SOCIETY OF BIBLICAL ARCHÆOLOGY.

April 2nd.—S. Birch, LL.D., President, in the chair.—The following papers were read: "Memoir of the late H. Fox Talbot," by Mr. R. Cull; "On the Names of Brass and Copper in the Cuneiform Language of Chaldea and Assyria," by M. F. Lenormant (précis by translator, M. E. A. Budge); "Translation of an Egyptian Contract of Marriage," by M. E. Revillout; and "On an Inscription of Psametik II. in the musoum at Palermo," by Miss G. Austin.

May 7th.—Dr. S. Birch, President, in the chair. — The following candidates were nominated for election by the Council: Mr. W. Besant, Rev. H. J. Hotham, Rev. F. Newton, Mrs. Paulet, and Mr. E. W. Rashleigh.—The following paper was read, accompanied by illustrations on the blackboard by the author, "On Kurdish Folk-Lore in the Kurdo-Jewish Dialect," by Rev. A. Lowry.

GEOGRAPHICAL SOCIETY.

April 8th.—Sir R. Alcock, President, in the chair.—The following gentlemen were elected Fellows: Major R. O. Jones, Rev. G. C. White, Messrs. R. C. Bailie, A. J. G. Bain, G. W. Field, N. T. Foster, J. L. Haddan, J. H. Hadwen, R. T. Jones, W. Kirby, J. Sivewright, R. P. Spice, R. E. Welby, D. Whalley, Rev. G. C. White, and S. H. Williams. The papers read were, "Travels in Western China and on the Eastern Borders of Tibet," by Capt. W. Gill, and "The United States' Topographical Survey of New Mexico," by Mr. T. W. Goad.

GEOLOGICAL SOCIETY.

April 3rd.—H. C. Sorby, President, in the chair.—Rev. A. A. Harland and Mr. T. W. Shore were elected Fellows. The following communications were read: "On an Unconformable Break at the Base of the Cambrian Rocks, near Llanberis," by Mr. G. Maw; "On the so-called Greenstones of Central and Eastern Cornwall," by Mr. J. A. Phillips; aand "On the Recession of the Falls of St. Anthony," by Mr. N. H. Winchell.

BRITISH ARCHÆOLOGICAL SOCIETY.

April 3rd.—Mr. H. Syer Cuming in the chair.—Mr. Luxmore exhibited a large series of Spanish keys of sixteenth-century date, in beautiful preservation, and presenting many peculiarities in their designs, which were very artistic. An animated discussion ensued, and Mr. Lambert and Mr. R. S. Ferguson described many of their peculiarities. Mr. L. Brook exhibited a large collection of ancient views and etchings of Spanish antiquities in illustration of one of the papers. Mr. T. Morgan described a collection of rare silver denarii and copper Roman coins, over 150 in number, which he had brought from Spain many years ago, and Mr. Grueber called attention to the most rare examples. Mr. Glaskett exhibited some sketches of the ancient caverns of Hastings and St. Leonards. The first paper was by Mr. T. Morgan, who traced the course of his recent Spanish tour, and briefly noted the early and mediæval history of the country. He then described the important Roman remains of Italica, and particularly those of the amphitheatre, a building of large dimensions, capable of containing 25,000 persons. It bears indications of an extended period for its construction, probably from the time of Augustus to Hadrian. There are ten principal approaches, and the extreme length of the elliptic plan is 514 feet by 414. The massive walls are of concrete, with some arches of tile, but the stone facing is almost destroyed, the building having been greatly demolished in 1711, and recently excavated. In the discussion which ensued, Mr. Grover compared the enormous area with the size of the Albert Hall, which could be readily placed within the open area only of the amphitheatre. He compared its size with the humble structures of Roman date in Britain, which were passed in review; and he noted the use of organs worked by water power by the Romans during the performances. The second paper was by Mr. Compton, who traced some peculiarities in old leases granted by the bishops of Hereford, a red rose being required on renewal of leases. Mr. G. R. Wright detailed the progress of the arrangements for the Wisbech congress in the autumn, and a vote of condolence on the death of Sir G. Scott was announced.

ARCHÆOLOGICAL INSTITUTE.

April 5th.—Sir J. Maclean, V.P., in the chair.—At this the first general meeting after the death of Sir G. G. Scott, the Chairman spoke of the loss that the Institute had sustained by his death, his long connection with the society, and his many valuable contributions to the history of art and architecture which enriched the pages of the "Journal." A resolution of condolence with Sir G. Scott's family was proposed by Canon Venables and seconded by Mr. J. T. Micklethwaite. Mr. C. E. Keyser read the conclusion of his paper "On the Mural and Decorative Paintings in Canterbury Cathedral." A memoir by Mr. T. Watkin, "On Britanno-Roman Inscriptions discovered in 1877" was taken as read. This was the second of Mr. Watkin's annual series. Canon Venables gave an account and exhibited the MS. Chronicle of the Cistercian Abbey of Louth Park, in Lincolnshire. This was a folio of twelve leaves, incomplete at the beginning. It was noticed that the water-mark of the paper was the same as that of the Hall Book of King's Lynn, of 31st Henry the Sixth (1452). The first page of the MS. begins with the close of the "tertia ætas" of the world's history—the epoch of Samuel and Saul. It goes regularly on to the fourth, fifth, and sixth "ætas," the age of the Crucifixion, and so on, with a general summary of civil and ecclesiastical history up to the verso of fol. 5, when a regular tabular chronicle begins year by year, commencing with 1067. The special purpose of the Chronicle, however, begins in 1139, the date of the foundation of the Abbey. Canon Venables gives a *resume* of the contents of the Chronicle, ending in 1413, with the death of Henry the Fourth. It was related how the MS. had long been missing, but had lately been rediscovered among the effects of the late Mr. Harrod. Mr. R. S. Ferguson exhibited a bronze female bust of Roman workmanship, four inches high and hollow. This beautiful object had been recently found in the bed of the river Eden, near Carlisle. It had formerly a lid on the top of the head and loops for suspension remain at the sides. A similar object from Lyons is in the British Museum, and it is considered that these articles served the purpose of receptacles for oil, to be suspended from lamps by chains. Another bronze female head was exhibited from the same locality. Mr. Ferguson also sent a bronze figure of a bat, with the wings extended over its head in the form of an acanthus leaf. Mr. Ferguson also exhibited two plumbago moulds of the time of Henry the Seventh, for the manufacture of base coin of that period. Mr. Ferguson explained, from his own practical experience as a base coiner — with these identical moulds—the exact manner in which they must have been used, and pointed out the great ingenuity that had been shown in their manipulation for dishonest purposes. Three of the coins were forgeries on the York mint, the other was a groat of Richard the Third. These unique moulds for antique counterfeits were discovered, in 1865, at Netherwasdale, in Cumberland. Mr. Ferguson also exhibited a box of silver money weights in low standard silver, fifteen in number, one of them being for the purpose of weighing against the Turkish ducat. Mr. J. A. Sparvel-Bayly exhibited a bronze celt, Roman pottery, and other objects lately found near Billericay, and read a careful account of Roman and other discoveries in the district. Mr. Hartshorne exhibited a painted glass roundel, successively the property of Horace Walpole, Mr. Cole, and Mr. Kerrich, said to be the work of Lucas of Leyden, and another roundel representing the siege of a town. Mr. Bernhard Smith sent two "porte-Couteaux" for the bill-hook, carried by wild tribes in the Deccan, and a Maori title-deed, carved in a piece of green jade, having a remarkable *chatoyant* lustre. Canon Venables exhibited photographs of the house of Aaron the Jew, at Lincoln, now being rebuilt, and gave a description of the building.

May 3rd.—R. H. S. Smith, Esq., V.P., in the chair.—Mr. J. H. Parker made some observations upon the progress of the excavations in Rome during the past season. The proposed destruction of part of the Agger of Servius Tullius by the railway company had met with great opposition. The chairman thought it desirable that the hands of the Roman antiquaries should be strengthened by protests from the principal English archæological societies, in the way Mr. Parker suggested, and the matter was referred to the next meeting of the Council. The Rev. C. F. R. Palmer contributed a paper "On the Provincials of the Friars Preachers or Black Friars of England," giving an account of the Order from 1215 to its dissolution in this country. A paper by Mr. W. T. Watkin, "On the Roman Stations Burrium, Gobannium, and Blestium, of the twelfth and thirteenth Iters of Antonine," was taken as read.—Mr. J. L. Baldwin exhibited a small English clock of the domed "button and pillar" type.—Mr. S. Tucker (Rouge Croix) pointed out that on the back was engraved, within a wreath, the royal arms of England, as borne by the kings of the House of Hanover (viz., with Brunswick in the fourth quarter), the whole surmounted by a cardinal's hat. It had been suggested that this clock belonged to the Cardinal of York. Mr. Tucker considered that it might be not unreasonably suggested that a foreign workman engraved the arms as they then were, and in ignorance of their meaning and of the curious impropriety of a Brunswick coat so marshalled for a prince of the House of Stuart. The style and date of the clock bore out this theory. There was no cardinal in the Brunswick family, and it could not be associated with a Bishop of Osnaburg.—Mr. M. H. Bloxam exhibited a bronze finger ring, inscribed inside ESYNERA EYNAISKE, probably a Roman "annulus nuptialis," and a bronze hammer, the only remains of the Roman period found in Rugby.—The Rev. J. F. Russell exhibited and described several painted and enamelled German glass roundels of the early part of the sixteenth century.—Mr. Hartshorne exhibited a piece of painted glass representing a remarkable event in the life of Sir Alexander Stuart, contained within a border exhibiting a "Jesse tree," with figures of men in armour bearing shields rising out of flowers, and having their names inscribed under them; the glass bore the date of 1574.—Mr. Tucker said that the tradition ran that Sir A. Stuart encountered and slew a lion with a club, after breaking his sword, in the presence of Charles the Sixth of France. The king gave him as an augmentation to his arms "a lion debruised with a ragged staff in bend." The augmentation was borne by descendants of Sir Alexander in various ways. William Steward, of Ely, living at the time of the Visitation of 1619, is recorded as having represented the incident on glass. The accurate description of the glass exhibited left no room for doubt that it was the actual picture in the possession of W. Steward, of Ely, at the time of the Visitation in 1619.—Mr. W. J. B. Smith exhibited a fine Venetian broadsword inscribed JOHANNES ZUCHINI, late sixteenth century, with a hammer-worked basket hilt.—Mr. S. Heywood also sent a sword, carried by an ancestor at the battle of Marston Moor in 1644. This was fox-marked, and bore the figures, 14 14, probably of no meaning. The armourer's mark was a crowned swan, which has not yet been appropriated to any special maker.—Lady C. Schreiber exhibited a sack pot of Lambeth pottery, lettered "Whit-Wine," and dated 1641, and the Chairman an example lettered "Sack," and dated 1657, together with some ewers and drug pots of the early part of the eighteenth century of the same ware.

ZOOLOGICAL SOCIETY.

April 2nd.—Prof. Newton, V.P., in the chair.—The Secretary read a report on the additions that had been made to the Society's menagerie during March. Letters and communications were read: from the Marquis of Tweeddale, on the collection made by Mr. A. H. Everett in the Island of Panaon; by Mr. A. G. Butler, "On new Lepidoptera of the Group Bombycites in the Collection of the British Museum;" from M. E. Oustelet, "On a new Species of Cassowary from New Guinea, proposed to be called *Casuaris Edwardsi*;" from Mr. F. Nicholson, on an apparently new species of American Pipit from Peru, which he proposed to call *Anthus Peruvianus*; and by Prof. A. H. Garrod, "On the Placentation of *Hyomoschus aquaticus* as observed in the Pregnant Uterus of a fresh Specimen of this Animal recently examined."

April 16th.—E. W. H. Holdsworth, Esq., in the chair.—Mr. Sclater exhibited and made some remarks on a typical specimen of the new Fox lately described by Mr. Blanford as *Vulpes canus*, from Baluchistan. Letters and communications were read by Prof. Westwood on the Uraniidæ, a family of Lepidopterous insects, with a synopsis of the family and a monograph of one of the genera, Coronidia. These insects were remarkable for their extreme beauty and the difficulty which had attended their systematic classification. Their relations with other groups of Lepidopterous insects were discussed at considerable length, and their nearest affinities were shown to be with ecrtain other moths belonging to the great division of the Bombyces, whilst their connection with the Hesperian butterflies, the Pseudo-sphinges, Erebideous Noctæ and Ourapterygerous Geometræ was disproved by their general structure, the venation of their wings, and their transformations. A synopsis of the species of all the genera was given, and a complete monograph with figures of the genus Coronidia, by Mr. Gwyn Jeffreys, the first part of his work on the Mollusca procured in the expeditions of H.M.'s steamships Lightning and Porcupine; the Brachiopods formed the subject of the present paper; by Mr. G. E. Loder, on a mounted head of the Rocky Mountain Bison; from the Marquis of Tweeddale, the eighth of his contributions to the ornithology of the Philippines, giving an account of some Luzon Birds in the Museum of Darmstadt, which had been sent to him for examination by Prof. Koch of that place; from Dr. O. Fincsh on a new species of Finch from the Feejee Islands, which he promised to name *Amblynura Kleinschmidti*, after Mr. Kleinschmidt, by whom it had been found in the interior of Viti-Levu: by Dr. M. Watson on the generative organs of the male spotted Hyena (*Hyæna crocuta*), and a detailed comparison of them with those of the female of the same animal; by Messrs. Sclater and Salvin, on the collection of Birds made during the voyage of H.M.S. Challenger at the Island of Juan Fernandez, at various points along the coast of Patagonia and at the Falkland Islands, and on three new species of Birds from Ecuador, proposed to be called *Buarremon leucopis*, *Neomoryhus radiolosus*, and *Aramides calopterus*.

CHEMICAL SOCIETY.

April 4th.—Dr. Gladstone, President, in the chair.—A lecture "On the Application of the Microscope to some Special Branches of Chemistry" was delivered by Mr. H. C. Sorby. The lecturer confined his discourse to the application of the microscope for determining the refractive indices of liquids and solids. If an object be placed on the stage of a microscope, and the focus be adjusted accurately, on placing over the object a plate of some refracting substance the object will be invisible; to bring it again into focus, the body of the microscope must be moved further out. If this distance be *d*, and the thickness of the plate be T, then the index of refraction $= \frac{T}{T-d}$. This distance can be measured either by a scale and vernier attached to the body of the microscope, or by graduating the head of the screw which works the fine adjustment. The lecturer then described the various methods by which the two quantities T and *d* could be practically measured to 1/1000th of an inch; the curious and diversified images seen by observing with a microscope a circle or a grating, through transparent plates of various substances, were then explained. Minerals having no double refraction are unifocal, *i.e.*, both systems of lines in a grating can be seen at the same focus. Minerals having double refraction are bifocal, *i.e*, only one system of lines can be seen at one focus, a new focus having to be found in order to see the lines at right angles to the first set. This method has enabled the author to identify various minerals in sections, 1/500th of an inch thick and 1/100th of an inch in diameter. Thus in a dolerite 1/400 of an inch thick, a zeolite, labradorite, calcite, and augite were identified with almost absolute certainty. In sections of shells 1/1000th of an inch thick calcite can easily be distinguished from arragonite. In conclusion the lecturer referred to the connection between the indices of refraction and chemical composition. The data are defective at present, but several points have already been made out; thus of two minerals having similar compositions, but one containing calcium, and the other one of the alkalies, the first has a higher index of refraction. A lime garnet, on the other hand, has a lower index than a precious garnet, which contains iron instead of calcium.

April 18th.—W. Crookes, Esq., in the chair.—The following papers were read: "On Terpin and Terpinol," by Dr. Tilden. The author prepared crystallised terpin, $C_{10}H_{20}O_2OH_2$, by Wigner's process, and obtained the same compound from American and French turpentine, but did not procure any crystalline substance from the terpenes of the orange group. By the action of dilute hydrochloric acid on terpin, an oily body, terpinol, boiling at 205-215°, was obtained, having the formula $C_{10}H_{18}O$. By the action of dry hydrochloric acid on terpinol a dihydrochloride was prepared. The author believes that in the preparation of terpin by the ordinary process terpinol is formed at a certain stage of the reaction. By acting on terpin with dilute sulphuric acid a hydrocarbon, $C_{10}H_{16}$, boiling at 176-178°, sp. gr. ·8526, was obtained. It is optically inactive, and gives no crystalline deposit with hydrochloric acid, and no crystalline nitroso compound. The author proposes to call it terpinylene. "On the Poisonous Principle of *Urechites suberecta*," by Mr. J. J. Bowrey. This plant grows wild in Jamaica. It has dark-green leaves and large bright yellow flowers. It is locally called "nightshade." It is known to be very poisonous. The author has extracted from the fresh leaves of the plant, by the use of alcohol, water, and a temperature not exceeding 38° C, a white crystalline body, urechitin, $C_{28}H_{42}O_8$, to the presence of which the plant owes its poisonous properties. It is very soluble in hot alcohol, chloroform, and glacial acetic acid, almost insoluble in water and dilute spirit. It is intensely bitter and poisonous; it gives with strong sulphuric a characteristic cold reaction: the liquid passing from yellow through red to purple. A trace of nitric acid increases the rapidity of the colour changes. If the leaves are dried at 100°, urechitoxin is obtained, either crystalline or amorphous. This substance resembles urechitin in its chemical and toxical properties. Both substances are glucosides. "On the Temperature at which some of the Alkaloids, &c., Sublime, as determined by an Improved Method," by Mr. A. W. Blyth. The author has determined the melting and subliming points of many active vegetable principles, and classed them in regard to their behaviour to heat for practical purposes. He has also devised a new method for determining the subliming points; it consists essentially in placing the substance on a thin cover-glass floating on a bath of mercury, and examining a second cover-glass placed over the substance from time to time with a ¼-inch objective, the mercury being gradually heated.

MICROSCOPICAL SOCIETY.

April 3rd.—H. J. Slack, Esq., President, in the chair.—Two new Fellows were elected. A paper was read by Mr. J. W. Stephenson, "On a new Immersion Object-glass," which had been designed by him to obviate the difficulty often experienced in the accurate arrangement of the adjusting collars of high-angled objectives. This new glass had a focal distance of one-ninth of an inch and a balsam angle of 130°; it was stated to bear very deep eye-pieces, and to have a very flat field. The great difficulty of obtaining an "immersion" fluid having the same refractive index as crown glass had at length been overcome by the adoption of oil of cedar wood diluted with one-fifth part of oil of funnel seeds. The objective was exhibited in the room at the close of the meeting .A paper was read by Mr. F. Crisp, "On the Present Condition of Microscopy in England," in which, as regarded a knowledge of the optical and mathematical principles of the instrument unfavourable comparisons were drawn between the workers at home and abroad, and a greater degree of attention to the construction of the various portions of the instrument was urged upon English microscopists. After the meeting Dr. Miller exhibited a small piece of a beautiful sponge, *Acarnus innominatus*, Gray, and Mr. Curteis some stained vegetable tissues.

May 1st.—H. J. Slack, Esq., President, in the chair. Four new Fellows were elected, and Prof. Abbe, of Jena, was elected an Honorary Fellow. A paper by Mr. Michael, "On a New British Cheyletus," was read by the Secretary; it minutely described the structure and habits of the insect, and was illustrated by drawings. The name proposed by its discoverer was *Cheyleytus flabellifer*.—Mr. C. Stewart gave a *resume* of a paper which had been received from Dr. O. Schmidt, of New Orleans, in continuation of a former communication "On the Blood Corpuscles of the Amphiuma, Frog, and Man." The President suggested to the meeting a series of experiments which he thought might be of value in the interpretation of optical images, by the examination of microscopic drawings of Lissajous' curves under various powers. He also brought before the notice of the Fellows a species of fungus which he had found infesting the leaves of the bay, but which did not appear to derive its nutriment from the leaf itself. After some discussion, the fungus was identified by Dr. M. C. Cook as *Capnodium Footii*, which was stated to live upon the honeydew found upon the surface of the leaves of a large number of trees, particularly in the autumn months.

PHILOLOGICAL SOCIETY.

April 5th.—Dr. J. A. H. Murray, V.P., in the chair.—A paper, by Mr. J. A. H. Sweet, President, "On Gender in the Teutonic Language," was read by Mr. Nicol. Four kinds of gender were distinguished: 1. Absence of gender, except in the specific words, "man," "woman," &c. 2. Natural gender, as in English, where male and female beings are respectively masculine and feminine, and inanimate things are neuter; other distinctions being also possible, such as the two-fold one of rational and irrational. 3. Metaphorical gender, by which inanimate things are regarded as male or female according to some fancied analogy. 4. Grammatical gender, by which things (and occasionally human beings) may be either masculine, feminine, or neuter, without regard to their meaning. The processes by which grammatical gender has been simplified or lost in the modern Teutonic languages were then examined, and some cases of the development of independent metaphorical gender were pointed out. Mr. A. J. Ellis gave an account of his trial of the telephone, and stated that this instrument could not at present be relied on to register all the variations of the sounds of the human voice. Messrs. E. L. Brandreth and R. N. Cust were appointed the delegates of the Society to the meeting ef the Congress of Orientalists at Florence in September next.

ASIATIC SOCIETY.

April 15th.—Sir E. Colebrooke, Bart., M.P., President, in the chair.—The Rev. H. Jones was elected a resident member. A paper was read, contributed by Major Mockler, "On the Identification of Places on the Makran Coast with the Notices in Arian, Ptolemy, and Marcian," in which the writer showed, by his own personal survey and experience, in how remarkable a degree the brief notices of antiquity coincide with the more careful and scientific surveys of modern investigators. A large number of Major Mockler's identifications agree with what we learn from classical sources; and, where they differ from those of Dr. Vincent, it is fair to believe that the occasional errors of that great scholar are mainly due to the imperfection of the modern charts, to which alone he had access. A second paper, by Mr. B. Shaw, "On the Canton of Salar," was interesting, as showing the existence, at the present time, of a Mohammedan Turki tribe, shut in, to the extreme east, between the Mongolians and the Chinese, and subject to the latter as the suzerains of the adjacent country.

ENTOMOLOGICAL SOCIETY.

April 3rd.—Mr. H. W. Bates, President, in the chair.—Miss E. A. Ormerod was elected a member of the Society. Mr. McLachlan remarked that the opinion expressed at the last meeting by Mr. J. P. M. Weale, as to the functional purpose of the cephalic process in *Termes triniverius* was corroborative of an observation already recorded in Hagen's "Monographie der Termiten." Mr. F. Grut exhibited, on behalf of the Rev. T. A. Marshall, a collection of insects which that gentleman had made in the Windward Islands. Mr. F. Smith exhibited a series of specimens of "harvesting ant," sent to Mr. Darwin from Florida by Mrs. M. Treat. Three series showed a gradation from large soldiers and small workers, all having acute dentate mandibles, having rounded teeth, and other specimens in which the teeth were obsolete. It was not, however, made clear whether intermediate forms of teeth were found in nests, or whether three distinct races existed. The species appeared to be identical with *Myrmica barbata* from Texas. Mr. A. A. Berens exhibited two examples of *Thestor Mauritinicus*, taken on the Atlas Mountains. Mr. M'Lachlan exhibited a coleopterous larva, sent from Zanzibar by Dr. Kirk. He also exhibited a portion of the stem of a coffee-tree which had been bored into by this larva, and which was especially remarkable on account of the presence of a series of conical holes, which opened a communication between the inner gallery and the atmosphere. Mr. W. C. Boyd exhibited and made some remarks on a specimen of *Ptelophoras lætus* taken at Deal. The Secretary read a paper, communicated by the Rev. T. A. Marshall, entitled "Notes on the Entomology of the Windward Islands." The Rev. H. S. Gorham communicated "Descriptions of New Species of Cleridæ, with Notes on the Genera and Corrections of Tynonomy." Dr. D. Sharp communicated a paper "On some Nitidulidæ from the Hawaiian Islands." The Secretary read a paper by Mr. J. P. Mansel Weale, entitled "Notes on South African Insects," and exhibited drawings made by the author in illustration. Mr. Wood Mason exhibited and made remarks on the insects referred to in the foregoing paper, and was followed by Mr. Meldola on the same subject. The following papers were also communicated: "On Display and Dances by Insects," by Mr. A. H. Swinton, and "On the Secondary Sexual Characters of Insects," by Mr. J. W. Slatter.

MATHEMATICAL SOCIETY.

April 11th.—Mr. C. W. Merrifield, V.P., in the chair.—Mr. A. Martin was elected a member, and Messrs. W. M. Hicks and T. R. Terry were proposed for election. The Chairman, on the recommendation of the Council, nominated Messrs. Brioschi, Darboux, Gordan, S. Lie, and Mannheim for the honour of foreign membership. Prof H. J. S. Smith read two papers, "Second Notice on the Characteristics of the Modular Curves," and a "Note relating to the Theory of the Division of the Circle." Mr. Tucker communicated a letter from Prof. Tait, and read an abstract of a pa,per by Prof. Minchin, "On the Astatic Conditions of a Body acted on by given Forces, ' and a portion of a paper by Mr. C. Leudesdorf, "On certain Extensions of Frullani's Theorem."

ASTRONOMICAL SOCIETY.

April 12th.—Lord Lindsay, President, in the chair.—M. C. Flammarion and Mr. A. J. P. Shepherd were elected Fellows. Capt. Abney read a paper "On the Photography of the Red End of the Spectrum." Photographs which he had taken were thrown upon the screen by means of the oxyhydrogen light. They showed that the plates, which were prepared in a manner which was not explained to the meeting, were sensitive to the red and ultra red rays of the spectrum, while the yellow and orange light was entirely inactive. Enlarged portions of the photographs, showing groups of lines between A and B, were also thrown upon the screen. These were taken by means of a defraction grating, and the lines were exquisitely sharp. The Astronomer-Royal referred to a letter which he had received from M. Fizeau, the President of the French Academy, stating that a committee had been formed for the object of erecting a statue to the late M. Le Verrier, and requesting that he would make the matter known amongst astronomers in England. Subscriptions would be received by M. Fizeau, or the Secretaries of the French Academy. Mr. Jenkins read a paper "On the Luminous Spot visible upon Mercury in Transit." After carefully comparing the observations of the transits of Mercury, which he had been able to collect, he came to the conclusion that the phenomena attending the May Transits, when Mercury is near to perihelion. In the former instances the spot of light upon the disc of the planet seems to be nebulous, and situated a little south and preceding the centre of the planet. In the November Transits it appears as a bright point of light without any sensible diameter. In the May transits also, according to Mr. Jenkins, the rings of light round the planet are dark and nebulous, while in the November transits they are bright and sharply defined. Mr. Jenkins drew especial attention to these phenomena in view of the transit of the 6th of May. The President drew attention to a large oil painting by a German artist, which was exhibited in the room. It represented sunset upon a lunar crater, with the earth shining as a three-quarter moon, relieving the intense blackness of the solar shadows.

NUMISMATIC SOCIETY.

April 18th.—W. S. W. Vaux, Esq., V.P., in the chair.—M. F. Lenormant, Dr. F. Kenner, and Prof. J. G. Stickel were elected honorary members. Mr. R. A. Hoblyn exhibited a complete set of the coins struck in 1828 by Mr. M. Young from original dies obtained by him from a member of the Roettier family, in the possession of which they had been since the end of the seventeenth century. The coins in question consisted of a pattern for a piece of sixty shillings, Scottish, of James the Second; a pattern for a piece of sixty shillings of James the Eighth; a pattern for a shilling or guinea of James the Third; a pattern, probably for a quarter dollar, Scottish, of James the Eighth; a piece in tin of James the Second, struck for the American plantations; and an electrotype of a pattern for an English crown of James the Third, the original of which is in the British Museum. Mr. C. F. Keary, M.A., read a paper "On the Coinage of the Vandals," who, with the Ostrogoths, were the earliest among the barbarian invaders of Roman territory to strike money bearing the name and title of the barbarian ruler.

METEOROLOGICAL SOCIETY.

April 17th.—Mr. C. Greaves, President, in the chair. M. M. Davy, Capt. N. Hoffmeyer, Prof. D. Ragona, and D. A. Wojeikoff were elected honorary members. The discussion on Waterspouts and Globular Lightning, which was adjourned from the last meeting, was resumed and concluded. The following papers were read: "On the Application of Harmonic Analysis to the Reduction of Meteorological Observations and the general Methods of Meteorology," by the Hon. R. Abercromby. The meaning of harmonic analysis is first shown, in reference to average barometric pressure, by tracing the geometrical and physical significance of every step from the barogram till the tabulated results are combined, a harmonic series. It is then shown that, whether we regard this series simply as an algebraic embodiment of a fact, or as a series of harmonic components, as suggested by Sir W. Thomson, it is simply a method of averages, and our estimate of its value must depend upon an estimate of the use of averages at all in meteorology. It is then pointed out where averages are useful, and their failure to make meteorology an exact science is traced to three causes, 1, that the process of averaging eliminates the variable effects of cyclones and anticyclones, on which all weather from day to day depends, and on this are based some general remarks on the use of synoptic charts, not only in explaining and forecasting weather, but in attacking such problems as the influence of changes of the distribution of land and water on climate and the cyclic recurrence of rain or cold; that deductions from averages only give the facts, and not the causes of any periodic phenomena,—the position of diurnal and other periodic variations in the general scheme of meteorology is then pointed out, and it is shown that their causes can only be discovered by careful study of meteorograms from day to day; 3, that in taking averages, phenomena are often classed as identical, which have really only one common property, for instance, rain in this country is associated with at least three different conditions of atmospheric disturbance, and it is necessary to discriminate between these kinds before meteorology can be an exact science. "On some Peculiarities in the Migration of Birds in the Autumn and Winter of 1877-78," by Mr. J. Cordeaux. Mr. Symons gave a verbal description of the recent heavy fall of rain on April 10th and 11th, the greatest amount known to have been registered being 4·6 in. at Haverstock-Hill.

INSTITUTION OF CIVIL ENGINEERS.

May 7th.—Mr. J. F. Bateman, President, in the chair.—The monthly ballot resulted in the election of twenty-seven candidates, viz., Messrs. J. H. Bostock, H. M. Bradford, H. A. Dibbin, J. H. Fox, A. Lupton, H. Rofe, and G. L. Roff, as members; and Messrs. E. Addenbrooke, Alfred Allen, jun., F. Baker, J. B. Ball, G. P. Carless, G. B. Chadwick, G. H. Crowther, G. W. Dickson, C. A. Friend, W. Greenwood, A. W. Lawder, W. Nicholl, R. J. G. Read, H. J. Richard, A. H. Rowan, H. A. O. Weiss, W. J. Wilson, B. F. Wright, W. Wright, and G. D. Wybrow, as Associates. The paper read was "On the Construction of Steam Boilers adapted for very High Pressures," by Mr. J. F. Flannery.

SOCIETY OF ARTS.

April 10th.—Capt. D. Galton in the chair.—Eight candidates were proposed for election as members. A paper, "On a New Method of Producing a cheap Heating Gas for Domestic and Manufacturing Purposes," was read by Mr. S. W. Davies.

April 25th.—Dr. Voelcker in the chair. —A paper "On the Purification of Water," was read before the Chemical Section by Mr. G. Bischof.

April 30.—J. A. Froude, Esq., in the chair.—A paper "On the Progress of Agriculture and Stock Farming in the Colony of Natal," was read before the African Section by Dr. Peter M. Sutherland.

May 1st.—Dr. B. W. Richardson, in the chair.—Eleven candidates were proposed for election as members. A paper "On the Reforms in House Construction Demanded by Sanitary Science," was read by Mr. J. Balbirin.

May 3rd.—Lord W. Hay in the chair.—A paper "On the Telegraph Routes between England and India" was read before the Indian Section by Major Bateman-Champain.

May 8th.—Lord A. S. Churchill in the chair.—Six candidates were proposed for election as members. A paper "On the Phonograph, or Talking-machine," was read by Mr. W. H. Preece.

HISTORICAL SOCIETY.

April 11th.—Dr. B. W. Richardson in the chair.—Mr. J. Heywood read a paper "On the Historical Progress of Free Thought." A paper, entitled 'Notice of Churchwardens' Accounts in St. Michael's, Bath, from 1349 to 1575," by the Rev. Prebendary Pearson, was read by the Secretary.

IRON BRIDGES OF VERY LARGE SPANS FOR RAILWAY TRAFFIC.

By Mr. T. C. Clarke, M. Inst. C.E., of Philadelphia.

The following gives the substance of a paper read at a recent meeting of the Institution of Civil Engineers, in which Mr. Clarke stated that since the year 1863, when a paper on the subject was presented by the late Mr. Zerah Colburn, no communication had been submitted to the institution relative to the construction of iron railway bridges of long spans, as practised in America. At that time the longest iron span in America was the central tube of the Victoria Bridge at Montreal, 330 feet in the clear. Since then, several bridges had been built with wider openings; and one had lately been completed over the Ohio River, at Cincinnati, with a clear span of 515 feet. This was the longest railway girder yet constructed, the next longest, the Kuilenburg Bridge, in Holland, being 492 feet. The arches of the Saint Louis Bridge were also 515 feet span. Almost all American bridges of spans exceeding 100 feet were pin-connected, instead of being united by riveting. That plan was preferred on account of the mathematical certainty with which the strains could be calculated, and the deflection or camber ascertained,—of the economy, ease, and celerity of erection, which for rivers subject to sudden floods was a matter of vital importance,—and because it was believed that the parts of a bridge could be more strongly united than by riveting, and that a considerable reduction was possible in the dead weight of iron.

Two of the latest and best examples of American long-span iron bridge constructions were chosen for illustration. One was the trussed girder bridge across the Ohio River at Cincinnati for the Southern Railway—515 feet between the bearings, and erected on temporary stagings of timber—designed and executed by Mr. J. H. Linville. The other was the bridge of three spans of 375 feet each, carrying the same railway across the Kentucky River, the engineer, in this case, being Mr. C. Shaler Smith. Both bridges were noteworthy for their economical design and for their comparatively small amount of dead weight.

The Ohio Bridge consisted entirely of rolled iron, pin connected. The girders were quadrangular, each $51\frac{1}{2}$ feet deep, the panels being $25\frac{3}{4}$ feet long, and the girders 20 feet apart from centre to centre. The weight of iron in the span of 515 feet was 1,176 tons. With a total load of 431 tons, the centre deflection of the east truss was $2\frac{3}{32}$ inches, with a permanent set of $\frac{1}{16}$ inch, that of the west truss being 2 inches, with no permanent set.

Advantage was taken by the Engineer of the Kentucky River Bridge, of two towers and sets of anchorage, formerly constructed for a suspension bridge across the canon, which had not been completed. The first panel of this bridge on each side was bolted to the towers, and was then corbelled out panel by panel. The towers were calculated to be strong enough to carry 196 feet of projecting spans. At this point the spans were supported by temporary towers of wood. The corbelling out process was continued until the above spans each reached the main iron piers, which were built up simultaneously, so that the two met in midair. Each half of the centre span was then corbelled out as before, until they met in the centre. At this stage of the work, the upper chords being in tension and the lower in compression, the former were nearer to each other than the latter by a few inches. The method of closing the gaps under the changes resulting from alterations of temperature was then described. Up to this time the bridge was a girder 1,125 feet long, continuous over three spans. But while the abutments on the cliffs were stationary, the iron piers rose and fell under changes of temperature, and so varied the strains on the web system. The shore spans were therefore hinged at points 75 feet from the piers, leaving a centre girder 525 feet long, supported by piers 375 feet apart. Both of the web systems of diagonal rods were consolidated into one member at the point of contrary-flexure, and were separated again after the hinge was passed. When the bridge was tested it was found that the movement of the lower chord tenons under the passing load was 1½ inch. Every effort was made to secure the uniformity of the modulaurs of elasticity of every part of the ironwork. Nevertheless, the variation in length, between the east and west chords, was 1 inch 1,125 feet. When the end-spans were loaded with 277 tons, and the centre-span unloaded, the central deflection was 1·52 inch, and the upward movement of the central span was 2·83 inches. With the centre-span loaded with 331 tons, and the end-spans unloaded, the central deflection was 3·5 inches, and the upward movement of the cantilever was 1·58 inch. With all the spans loaded, 814 tons in 904 feet, the centre-deflection of the centre-span was 1·62 inch. The Kentucky River Bridge occupied four months and four days in erection, the average number of workmen employed being fifty-three. The average cost of erection was about £2 10s. per ton. The weight of iron in the bridge was 3,654,271 lbs. The depth of the truss was 37½ feet, and its width was 18 feet. The iron pier at the base was 28 feet by 71½ feet; at the top it was 1 foot by 18 feet; and it was 177¼ feet high. This was one of the boldest and most original pieces of bridge engineering in America. Both it and the Ohio River Bridge were conspicuous for economy of design. Economy of design was obtained by proportioning all the parts of a bridge with a similar factor of safety, and then combining those parts into a whole; and, secondly, by using such proportions of height of girder, length of panel, and combination of parts; also, such width apart between the girders, and such methods of bracing the two into a structure able to resist wind pressure or shocks, as would accomplish the first requisite with the least quantity of metal. The problem could only be solved by a tentative process. To show how this had been accomplished the Author gave a table showing the weight of iron and other important data of some of the most conspicuous long-span railway bridges constructed in Europe and America, and contrasted several of the examples cited. Finally the author stated that the workmanship of long-span bridges in the United States was generally first class; and that the price of American bridge work had fallen year by year, from £40 6s. per ton in 1870 to £20 16s. per ton in 1877.

GEOLOGICAL SCIENCE AT CAMBRIDGE.

In extracting the following article from the pages of our contemporary, the *Mining Journal*, we must add that we heartily endorse its statements:—

Upon the occasion of presenting the first Lyell medal and the entire proceeds of the fund to Prof. John Morris, F.G.S., by the President of the Geological Society, the opportunity was taken by him to remark that in making the award to one whose name was so intimately connected with the progress of geological science the council unanimously felt that they were best carrying out the intentions of the founder and attaching an importance to the medal which would show that, though founded later, it takes an equal rank with other medals at the disposal of the council; and the senate of the University of Cambridge have now shown an equal appreciation of Prof. Morris's ability as a teacher, and of the science which he cultivates in conferring upon him the degree of **Honorary Master of Arts**, the grace for which was brought forward and passed on May 10th. The exertions of Prof. Morris as a geologist extend over the long period of more than 40 years, and for more than three-fourths of that time he has been one of the most active of the Fellows of the Geological Society, almost constantly occupying a place on the council, and at present he holds the position of President of the Geological Association. He has always recognised the fact that "science without being applied is but an intellectual fragrance," and that "art guided by science is the master power of the world."

Whenever the opportunity presented itself for the encouragement of geological study, Prof. Morris has been most anxious to lend his assistance, and the instruction which he imparted during his 20 years occupation of the professorial chair in the University College, London, was by no means limited to his teaching within the college walls. His failing health necessitated retirement, but the College Council unwilling entirely to sever the connection, formally voted him the title of "Emeritus Professor," in consideration of his eminence in connection with the science of geology. His Catalogue of British Fossils has long taken rank as a standard work, and at the time of its publication the Geological Society awarded him the Wollaston Fund in recognition of its value, and it has been stated from the presidential chair of that society that his communications both on geological and palæontological subjects had been of high value and importance, and that his lectures had done much to spread a taste for geology, and to enlarge the number of its students, whilst the part which he had taken in the discussions showed astonishing minuteness of knowledge of every branch of geology and palæontology, and immense power of memory to be able to apply it.

For several years Professor Morris delivered courses of popular lectures on coal and coal mining at the Coal Exchange, which were highly appreciated, and he has also enlightened appreciative audiences upon his favourite subject, both at the Royal Institution and London Institution, and for two years he lectured at Cambridge for the late Prof. Sedgwick. His sound knowledge was also recognised in his appointment of examiner in Natural Science at Cambridge for the Tripos, and for the University of London, the War Office, the Admiralty, the Civil Service, and the Indian Engineering College at Cooper's Hill. He was also the recipient of a handsome and substantial testimonial, in the promotion of which the late Sir Roderick Murchison and John Phillips, of Oxford, took the principal part; and still more recently the Geological Society of Vienna and the Natural History Society of Philadelphia have recognised his merit in sending him diplomas of honorary membership, and he has also been presented with the freedom of the Turners' Company, and of the City of London.

The honour now conferred by Cambridge may well be regarded as the highest yet awarded to him, and it may be hoped that he may long live to enjoy it, and at the same time assist in promoting that science, his devotion to which has entitled him to it.

THE BRAIN OF THE CHIMPANZEE.

We are favoured (says the *Scientific American)*, by Dr. E. C. Spitzka with a more detailed report of the autopsy of the dead chimpanzee recently made at the New York Aquarium before many distinguished surgeons and scientists of that city.

Species, *Troglodytes niger* (chimpanzee); sex, male; age, about two years. All the organs greatly resemble those found in the human race. When the brain was removed all present were struck by its being almost indistinguisable from that of a human infant, especially at the base. The cerebrum was richly convoluted and overlapped the cerebellum about one-third of an inch.

It had also the same lobes, and was as rich in convolutions as the brain of a Bechuana, possessing also a well-developed island of Reil. Careful examination, however, showed that it had also an operculum of the occipital lobe, which is not found in the human subject. One of the most interesting features of this brain was the absence of a trapezium, and the presence of the olivary bodies.

Now, although a rudimentary olivary body exists in the lower mammalia, yet it causes no perceptible prominence of the medulla, and such a prominence is first indicated in the baboon.

But in this chimpanzee it was as full and large as in the human race, a fact in full accord with the high development of the lateral robes of the cerebellum, for the olivary bodies keep pace in development throughout the animal kingdom with the development of the cerebellar hemisphere.

The island of Reil, whose relations to the higher faculties are strongly documented by the prevailing physiological belief that it is subservient to the faculty of speech, was also in this instance large and well developed.

Dr. Spitzka, who is making observations on the brains of other animals, will make a special microscopical study of the present specimen, the result of which will be published later.

DRAAISBOSCH.

When the din of encounter was o'er,
And your valorous spirit was known;
One true heart, on your own native shore,
Felt the fame you had won for your own.

From the scenes of fair Africa's air
Rose the visions where fancy will roam:
As the stars which shine o'er us oft bear
The fond dreams of our old English home!

Wilt thou linger to think I am glancing
O'er the same silent fields of deep blue?
While mem'ries my heart are entrancing
With fond visions unfading of you!

Ev'ry path we have trodden together,
Ev'ry flower we have both gazed upon,
All the stormy and sunshiny weather
We have braved, o'er above us has shone:

Each star which has throbbed as our hearts beat
At the passionate night-breath of June;
The grass, and wild flowers round our feet,
In the lanes neath the gold August-moon.

Let them bring all the joy to your soul
They've absorbed from our mem'ries tears;
Till the slow time is slain, and the goal
Is made bright thro' the sadness of years

V. Gonville D.

The City Press.—During the past month the *City Press* has been issued *twice a week* (Wednesdays and Saturdays) instead of weekly as heretofore. The paper is under the same management with regard to both the editorial and the publishing departments. The *City Press* is a newspaper for the Metropolis, and in addition to the record of current events, it treats upon the antiquities, laws, customs, usages, rights, privileges, courts, churches, chapels, charities, clubs, parochial boards, places, and People of the City of London.

Mr. T. B. Bonney's "Physical Geography" (Society for Promoting Christian Knowledge) is a lucid treatise adapted to the Schedule in the New Code of Regulations for 1876.

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